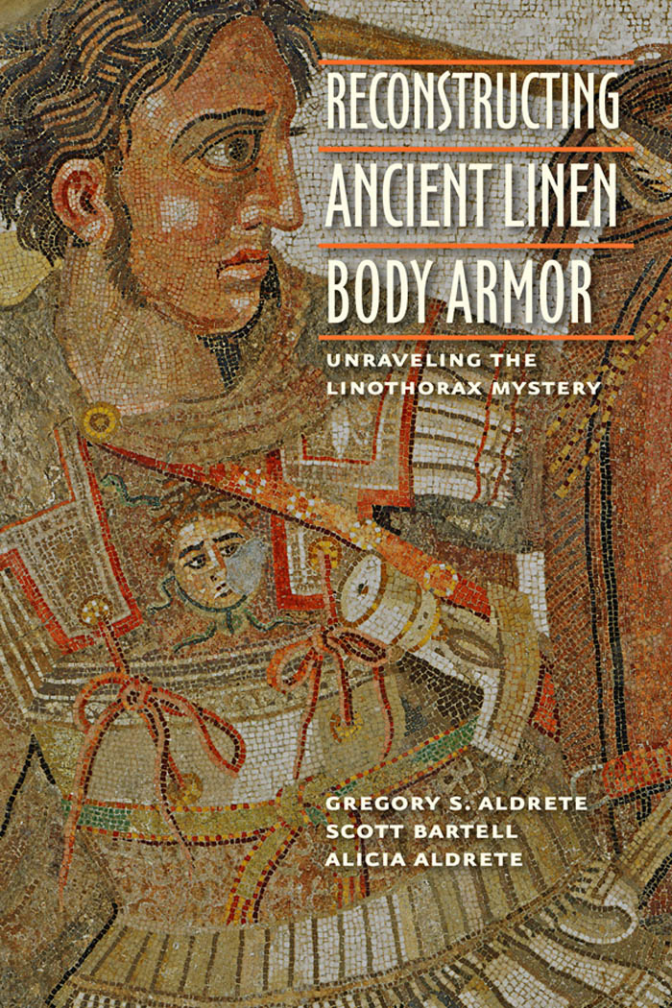

RECONSTRUCTING ANCIENT LINEN BODY ARMOR

UNRAVELING THE LINOTHORAX MYSTERY

GREGORY S. ALDRETE
SCOTT BARTELL
ALICIA ALDRETE

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Reconstructing
Ancient Linen Body Armor

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Although the authors of this book are the principal investigators, over the past six years the Linothorax Project at the University of Wisconsin–Green Bay has involved large numbers of other people, and it has grown into an ongoing collaborative faculty-student research project. Among the participants have been dozens of undergraduate history students and members of the Ancient and Medieval History Club, a student organization. These students have voluntarily contributed their labor and ideas during all stages of the manufacture and testing of the reconstructions and sample patches. Their vital role in this research is gratefully acknowledged. While they received no credit or compensation for their efforts, we greatly appreciate their constant hard work and perpetual enthusiasm. Some of the especially active student contributors include Elizabeth Carlson, Gina Covert, Elijah Dufek, Alicia Engstrom, Maggie Gertz, Kyle Gorman, Michael Jacobs, Kurt Kuschel, Scott Leibbrandt, Jeramy Nitke, Lisa Noel, Abbie O'Toole, William Schwartz, Thomas Sutphin, and Shawn Wilcenski.

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We gratefully recognize the contributions to our project of a number of community members. Experienced bow hunters Peter and Jeffrey Hillesheim served as expert archers for several of our test shoots, and master weavers Kati Meek and Sara von Tresckow provided much technical assistance. Sara not only was a font of invaluable advice about the practical aspects of growing and processing flax and of spinning and weaving linen, but she even supplied many of the handspun, handwoven linen samples used in our tests. We would also like to acknowledge the assistance of the Green Bay Police Department with ballistics testing. Johannes Wiebus and Jynx Productions filmed a short documentary about the project, and their high-speed cameras provided us with additional ballistics data. Similarly, we would like to thank the Discovery Channel for providing access to a ballistics gel dummy while filming a piece about our research.

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As always, while many have contributed to this book, the opinions expressed are those of the authors alone, and any errors are ours as well.

Reconstructing
Ancient Linen Body Armor

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Introduction

As numerous references in primary sources attest, one form of body armor used throughout the ancient Mediterranean world was the *linothorax*, a type of armor apparently composed mainly of fabric. In modern scholarship, however, the linothorax has been relatively neglected, and when it is addressed, the mentions are usually brief. There are two explanations for this lack of scholarly notice. The first (and undoubtedly the main) one is quite understandable: because of the inherently perishable materials of which the linothorax was made, none has survived intact. The contrast is especially sharp when one considers the many fine examples of bronze armor that are extant. Scholars are fond of making typologies, but it is difficult to do so when there is nothing to examine.

The second reason is that there seems to be general skepticism as to whether any armor that uses cloth as a basic component can offer credible protection to its wearer. This has led to much speculation that the cloth might have been only a superficial covering over supposedly tougher substances such as leather or that the fabric concealed metal plates, or a whole range of similar hypotheses. In modern popular media and in some scholarship, the figure of the ancient hoplite, the heavily armed Greek foot soldier, has been idealized as a heroic "man of bronze" encased in metal armor, leaving little room for the possibility of other forms of protection. Between the lack of extant examples, the doubts as to linen armor's effectiveness, and the dominant image of the bronze-covered hoplite, the linothorax has been underappreciated. Ancient sources, however, suggest that the linothorax enjoyed a long reign on the battlefield, from Archaic Greece through the Hellenistic era, and that it may even have been the armor of choice for many warriors in the ancient Mediterranean world.

The Linothorax Project is an exercise in reconstructive archaeology that has attempted to illuminate some of the mystery surrounding this type of armor. This project, which began at the University of Wisconsin–Green Bay in 2005, has had four main goals: first, to collect in one place all the evidence for ancient linen body armor from both literary texts and visual sources; second, to reconstruct full-size versions of the linothorax based on these sources in order to understand the construction, form, and function of this armor; third, to build plausible examples

Fig. I.1. Typical linothorax depicted on an Athenian red-figure stamnos by the Achilles Painter, c. 450 B.C. (R-187)

employing only the materials and techniques known to have been widely available to the ancient Greeks; and, fourth, to subject these reconstructions to controlled testing in order to determine whether this type of armor would have offered a viable form of protection to its wearer. (See plate 1 and fig. I.1.) The results of these experiments strongly suggest that the linothorax's long employment on ancient battlefields may have been because it not only provided surprisingly effective protection but also may have had significant practical advantages over comparable metal body armor.

The State of Linothorax Scholarship and Typologies of Greek Armor

As an ancient artifact, the linothorax is a bit anomalous in that the scholarly literature on it is relatively scanty, but it is comparatively well known among a broader general audience. The linothorax is a staple of popular reference books on ancient warfare and features prominently in numerous computer, video combat, and his-

torical simulation games. For example, it is described as standard armor and is highlighted in vividly imagined illustrations in the widely read Men at Arms and Warrior series from Osprey Press.[1] It similarly appears as a standard piece of equipment in influential general-audience reference works on ancient warfare written by respected authors, such as *Greece and Rome at War* by Peter Connolly and *Warfare in the Classical World* by John Warry. Finally, a substantial number of quite dedicated hoplite reenactor groups and amateur ancient warfare enthusiasts have tried their hands at fashioning their own versions of the linothorax using a range of materials and patterns.[2]

The treatment of linen armor in more academically oriented works is considerably less extensive. Despite excellent scholarly books and articles exploring aspects of ancient warfare, and particularly the hoplite-style combat of the ancient Greeks, linen armor typically receives only brief mention. For example, the recent magisterial (and massive) *Cambridge History of Greek and Roman Warfare, vol. 1: Greece, the Hellenistic World and the Rise of Rome* contains only four passing mentions of linen breastplates and no discussion of their quality other than the casually denigrating remark that many hoplites had to "make do" with a breastplate of linen rather than bronze.[3] The standard treatments of Greek warfare reflect this pattern. Thus, Anderson's (1970, 20–22) pioneering work on Greek warfare gives the topic just three pages; Snodgrass's (1999, 90–91) influential survey of Greek arms and armor gives it two; and Hanson's (1989, 77) innovative reexamination of hoplite warfare gives it one. In the past 10 years, however, there has been a pronounced increase in interest in linen armor. Jarva (1995, 18–19, 33–47), Schwartz (2009, 70–73), and Everson (2004, 110–14, 145–59) offer by far the most extensive modern treatments of Greek linen, leather, and composite armor. Lush (2007) presents the fullest discussion of the case for the Macedonians' use of linen armor, and Gleba (2012) thoroughly examines the visual evidence for widespread use of linen breastplates by the Etruscans.[4]

In contrast to the relative dearth of scholarship on the linothorax, metallic Greek body armor has been the subject of considerable academic attention, no doubt because hundreds of examples of such metal armor, predominantly made out of bronze, have been recovered by archaeologists from burials and sanctuaries. The seminal work is Arnold Hagemann's *Griechische Panzerung, Eine entwicklungsgeschichtliche Studie zur antiken Bewaffnung, Teil 1: Der Metallharnisch* (1919), which laid out an influential typology for ancient Greek armor.[5] Hagemann traces the development of the solid metal breastplate from the archaic "bell cuirass" (*Glockenpanzer*) dating to roughly 750–500 B.C., through an improved version in the fifth century B.C., to the final "muscle cuirass" (*Muskelpanzer*) form, which he

claimed also emerged as a distinctive type around the same time. This terminology has continued to pervade subsequent discussions, although more recent archaeological finds have complicated and challenged his timeline. Hagemann's book was intended as the first part of a multivolume series, and a subsequent volume would have covered body armor made of other materials, including leather and cloth. Regrettably, these volumes were never finished and, perhaps partly as a result, Hagemann's typology of solid metal armor has dominated most later scholarly discussions, including those by Anderson, Snodgrass, and Hanson.

A major step forward from this early foundation was the 1995 publication of Eero Jarva's *Archaiologia on Archaic Greek Body Armor*, which does an excellent job of updating and expanding Hagemann's work and which considers both metal and nonmetal types of armor. Jarva offers a typology in which the bell cuirass is classified as Type I, a similar plate cuirass lacking the characteristic upturned bell-like curve at the bottom is Type II, and the muscle cuirass becomes Type III. Jarva then proposes a Type IV, which he calls "composite corselets," that includes armor made of leather and textiles as well as corselets constructed from these that were either partially or fully covered with metal scales.[6] Whatever the material, all examples of this Type IV armor have a distinctive appearance in iconographic images (discussed in the section on visual sources in chapter 1). Finally, he adds a Type V, which is a rarely seen hybrid combining the upper part of a solid plate cuirass with composite materials on the lower half.

Under this typology, the linothorax would be classified as a subcategory of Type IV body armor. This same class of armor is often referred to as the "shoulder-piece corselet" or "tube and yoke" armor by some modern commentators because of the distinctive shape of its features.[7] In this book, we follow Jarva in applying the terms *Type IV* body armor to the general class of armor with this shape and *linothorax* when we specifically mean armor of this type that is made predominantly out of linen or other textiles. Occasionally, authors have attempted to make distinctions among these types of armor by labeling metal body armor *cuirasses* and reserving the term *corselet* for those made of leather or fabric. Because of the lack of terminological standardization, we will simply use *cuirass* and *corselet* interchangeably in this book to mean body armor.

The Structure of This Book

The first chapter offers a comprehensive survey of the available evidence for linen armor in the ancient world: mentions of linen armor in written texts and images of

Type IV armor (of which linen armor is a subcategory) in ancient art. The word *linothorax* is employed by a number of ancient authors and commentators, and there are also dozens of explicit references to body armor made out of linen, as well as others that can be interpreted as doing so. These sources testify that such armor was known from at least the eighth century B.C. through the Roman period and was employed by many different peoples around the Mediterranean, including the Greeks. The visual evidence consists of 913 images of Type IV armor found in a range of contexts, including on ceramic vases, in stone and terracotta reliefs, in wall paintings, and on bronze objects. Of these, by far the most common is red-figure vase paintings. This chapter also contains a brief description of flax growing and processing in the ancient world.

The second chapter uses the information gathered in the visual database to assess variations in the structure of Type IV armor. This analysis revealed some chronological trends in terms of the popularity of specific structural variations, such as the shape of the shoulder flaps, the methods used to attach the shoulder flaps, the arrangement of the *pteruges* (the protective skirt of leather or fabric strips), and the use of added scales. The second half of the chapter looks at decorative trends in the visual images, and we offer (perhaps for the first time) a systematic analysis of what patterns, images, and colors ancient warriors chose as adornment for their body armor.

Chapter 3 considers the material used to construct Type IV armor, a contentious issue because no corselets are extant. Close examination of the visual images reveals that the armor had to have been made of a substance that possessed an unusual combination of flexibility and rigidity. This chapter systematically investigates the possibilities for this material—sewn fabric, laminated fabric, and leather—and explores the arguments for and against each one. We argue that laminated linen was the most common choice, although the lack of standardization in the ancient world meant that versions using all of these materials (as well as combinations of them) almost certainly existed.

The fourth chapter shifts from the examination of ancient evidence to our exercise in reconstructive archaeology, in which we fabricated several variants of the linothorax. It offers a step-by-step guide to what often turned out to be a process of trial and error. Some of the major issues addressed in this chapter include our attempts to backwards-engineer a pattern based on the visual images, identifying and experimenting with not only fabrics and glues that were as historically authentic as possible but also the stages of the construction procedure. The experience of building the armor revealed useful insights beyond what was possible through studying

the textual and visual evidence. The chapter ends with a brief discussion of the dependability of the visual sources, with specific reference to heroic nudity and armor length.

Chapters 5 and 6 together describe another phase in our experiments: how we assessed the protective capabilities of linen armor by shooting various test patches with arrows under scientifically controlled conditions. Chapter 5 outlines the methodology of our test procedures, detailing how the patches were constructed, what types of bows and arrows were used, and why we focused on arrow attacks. Chapter 6 presents the test data in tabular form and discusses those variables that had significant effects on the results. The key conclusion emerging from these tests was that a linothorax with a thickness of one centimeter would have offered sufficient protection against the sort of arrow attacks likely to have been encountered in the ancient world from the sixth through the third century B.C.

Chapter 7, on wearability, examines the advantages and liabilities of linen armor, with an emphasis on insights that we gained while wearing our reconstructed linothorakes. It includes a discussion of the potential vulnerability of such armor to moisture and our experiments with waterproofing. Ease of repair, durability, range of motion, weight, and coolness are also explored in this section. Two of the greatest advantages of linen armor—its light weight in comparison to other types of corselets and linen's attractive property of staying cool in hot climates—would have benefited troops thus equipped in terms of mobility and endurance.

Chapter 8 reflects briefly on some of the broader economic and social implications of making body armor out of linen in the ancient world. The chapter begins with an attempt to calculate the number of hours of labor that might have been required for the various stages in construction of a typical linothorax and then considers who might have been performing this labor and where it might have occurred. This naturally leads to an analysis of the cost of a linen corselet, how this might have compared with that of other common types of armor, and whether there was a general market for linothorakes. Alexander the Great's army is used as a test case to consider issues of potential large-scale production. Finally, the chapter looks at the possibility that this may, unusually, have been a category of military equipment that women might have played a major role in producing, some of the implications for this manufacture, and the contexts within which it might have taken place.

The appendix consists of a database of 913 images of Type IV armor organized by the type of object on which the image appears. For each of the individual items in this database, we have tried to supply (when known) a brief description of the image, information about the object itself (including provenance and current loca-

tion), a date for the object, an inventory number, a reference to a standard system of cataloging such as the CVA, and a citation for a standard or widely available publication in which a photograph of the image can be viewed. Although many of the entries lack one or more of these bits of information, and while there are no doubt Type IV images that we have missed, our catalog of Type IV images is the first comprehensive attempt to collect this information in one place, and we hope that it will serve as a starting point for others to expand and improve upon.

Methodology and Audience

This book is somewhat unusual in terms of both methodology and intended audience. While the analysis of literary and visual sources falls comfortably within the standard range of approaches used by scholars to study the ancient world, other techniques are less commonly encountered in academic studies. In particular, the chapters describing the experiences of constructing and testing linen armor exemplify a set of practices variously called experimental archaeology, reconstructive archaeology, or reenactment research.

Although the methods of experimental archaeology have been widely employed for many years, one occasionally still encounters a certain degree of skepticism regarding their validity.[8] In an article addressing these doubts, W. B. Griffiths somewhat deliberately overstates the case when he writes: "It remains true that many classical historians and archaeologists do not see the subject [reenactment] as having much value, partly because it does not, in their eyes, deal in primary evidence first hand. Indeed it enters the almost taboo world of 'speculation'!"[9] Also, the conclusions reached through experimental archaeology may be viewed with suspicion owing to a real or perceived "lack of rigor and attention to scientific experimentational procedure in design, execution, recording, and analysis."[10] Admittedly, acceptance of this methodology has not been helped by occasional high-profile examples of poorly executed or sloppily researched reconstructions. As with any type of research, if it is not done well, its conclusions will be suspect, and this basic truth is no more or less true of experimental archaeology than of any other methodology. It may be particularly easy and tempting to fixate upon and ridicule instances of bad experimental archaeology, but within certain subfields of ancient history and archaeology, there is a solid record of well-done reconstructive research. Archaeologists of the prehistoric period have made particularly good use of experimental archaeology to enhance our knowledge of these cultures.[11] In ancient Mediterranean studies, reconstructive approaches are a long-standing staple of much useful and well-regarded scholarship on Roman military equipment, and just within

the past 10 years there have been several serious projects investigating Roman gladiatorial combat.[12]

To be acceptable as valid scholarship, experiments in re-creating and testing ancient equipment need to meet certain standards. First of all, such endeavors must be based as much as possible on primary sources and archaeological evidence. Second, any tests performed with reconstructions must adhere to standard experimental practices concerning methodology and replicatability. Publication of such experiments must contain clear and explicit information concerning materials used, procedures followed, and any assumptions made. Finally, it must be acknowledged that the conclusions resulting from these experiments represent possibilities rather than absolute certainties. Thus, while we can reconstruct a piece of armor that is as close in form and material to those used by ancient warriors as our knowledge permits, and can even extrapolate a range of performance data from tests on such armor, this reconstruction is not, and can never be, a fully authentic piece of ancient equipment. It is an approximation that, no matter how asymptotically closely it approaches historical reality, nevertheless remains a modern construct. If done well, however, it is one that is soundly based on a critical interpretation of the available sources; and what is any work of good scholarship if not a construct based upon a critical interpretation of the available sources? From this perspective, experimental archaeology is simply one more analytical method that can help to inform us about aspects of the ancient world.

Where experimental or reconstructive archaeology can be especially beneficial is in filling in gaps where the existing evidence is either scanty or lacking. For instance, in the case of the linothorax, we have numerous ancient literary references to and hundreds of ancient images of a specific type of armor, but no surviving examples. By constructing and testing modern replicas of this armor that are as historically accurate as possible, we can suggest a plausible, or even likely, range of its characteristics, even if we cannot know exactly what such armor would have been like. Some of these characteristics may help to confirm existing knowledge or interpretations. Occasionally, the experimental data may be unexpected and might suggest new ways of viewing or interpreting the existing evidence, thus both broadening and deepening our cumulative understanding of antiquity.

One unanticipated aspect of our foray into experimental archaeology that had both positive and negative effects was the attention that the project attracted from local, national, and even international mass media. We ended up being the subject of a number of articles in magazines, newspapers, and online news sources and appeared in three documentaries. These included articles about our project in *U.S. News and World Report*, *Der Spiegel*, *Military History*, and other magazines pub-

lished in Germany, Italy, and Poland; online news articles by Discovery Channel News and MSNBC, which were translated into at least 14 languages and reposted by other news services around the world; and four local TV news features, as well as segments on the Discovery Channel series *Penn and Teller Tell a Lie*, the Canadian History Channel series *Museum Secrets*, and the German television program *Galileo*.[13]

In these venues, our research was reported with widely varying degrees of seriousness and accuracy, and while it was gratifying to see the interest in ancient history that this media coverage elicited from the general public, it was also a constant source of frustration when our work was presented in simplified, misleading, or outright incorrect form. While some of the reporters were interested in trying to present our work accurately, others were more focused on entertaining their audiences, and all naturally tended to emphasize the most sensationalistic aspects and to represent any findings as "new discoveries" whether they were or not.[14] We quickly learned that we could not exercise final editorial control over how we were represented and that some simplification and distortion of our research were inevitable. However, our collaborations with the media had some pronounced positive effects on our research because they provided access to equipment (such as high-speed cameras and a ballistics gel dummy) that we would otherwise have been unable to afford. These sorts of experiences, both positive and negative, are something that other academics contemplating engaging in experimental archaeology might want to consider before they undertake their own projects, and a conversation among academics about how to handle such issues might be a fruitful one.[15]

In the same way that this book attempts a synthesis of theory and practice employing a range of interpretative techniques, its potential readership most likely will be drawn from several sometimes overlapping but nevertheless distinct groups of people with different purposes, goals, and expectations. The most obvious audience is traditional academics interested in historical, archaeological, or art-historical aspects of the topic. The second and largest group is the military history enthusiasts among the general public, especially those interested in hoplite warfare or the exploits of Alexander the Great. Ancient warfare reenactors compose a smaller but particularly enthusiastic third audience. Among these can be found the rather specialized group of amateurs and academics whose passion lies in reconstructing ancient weapons and armor and subjecting them to scientific testing in order to better understand their capabilities.

The methods, subject matter, and styles of presentation employed in the various chapters of this book reflect the interests of these audiences. Traditional academics may find the chapters dealing with the extant evidence for this type of armor and

the accompanying debates about it most agreeable, but they may consider the chapters describing our reconstructions and our experiences with them uncomfortably speculative for those in a field accustomed to acknowledge as valid only information that comes with an ancient citation. Conversely, the step-by-step account of our trial-and-error attempts at reconstruction will perhaps be of particular interest to historical reenactors, while other readers might find the gritty details of this process a bit tedious. Some casual readers may feel that the excursions on topics such as how to process flax fibers to be more than they ever wanted to know about certain subjects, while others will relish passages that intersect with their own particular interests. Finally, the scientifically oriented reader is most likely to enjoy the occasionally arcane mathematical calculations in the chapters on test methodology and results.

One risk of attempting to address such diverse audiences is that our book may end up satisfying none of them. While no doubt some sections of this book will be of greater interest to certain audiences than others, it is our sincere hope that all of our readers will appreciate, at least to some degree, the different types of knowledge about the ancient world that can be gained through the various methodologies that we have employed over the course of this project.

Ancient Evidence for Linen Armor

The two main types of evidence for the existence and appearance of the linothorax are mentions in written texts and visual depictions in vase paintings, wall paintings, and sculptural reliefs. References to linen would not be unexpected, for the fabric was in common use in the ancient world and the flax plant was native to much of the Mediterranean world.

Literary Sources

The generic word used by ancient Greek authors to refer to any sort of body armor, whatever its composition, was *thorax* (θώραξ), literally meaning "chest."[1] In translations, this term is usually rendered as "corselet," "cuirass," or "breastplate." The term *linothorax* (λινοθώραξ), therefore, is literally translatable as a "linen corselet," and it turns up early and prominently in Greek literature, featured twice in the famous ship list from Book 2 of Homer's *Iliad*. The lesser Ajax, leader of the Locrians from the mainland of Greece, is described as employing such armor: "He was small of stature, with a linothorax" (ὀλιγος μὲν ἔην, λινοθώραξ, 2.529). The word appears again a few hundred lines later at 2.830: "These were led by the linothorax-wearing Adrastus and Amphius, the twin sons of Merops of Percote" (τῶν ἦρχῳ Ἄδρηστός τε καὶ Ἄμφιος λινοθώρηξ υἷε δύω Μέροπος Περκωσίου). Obviously referring to these passages, Pliny the Elder states that, for this era, "Homer testifies that warriors, though only a few, fought in linen corselets" (*Natural History* 19.6). In addition, there are at least 17 instances when later commentators or scholiasts of Homer, including Aristonicus and Eustathius, quote the word when citing or repeating these two passages.[2] If Homer is to be believed, linen armor was in use at this time by cultures on both sides of the Aegean.

The term *linothorax* (or *linothorex*) also occurs twice in Strabo's *Geography*. At 13.1.10, Strabo repeats verbatim Homer's description of the linothorax-wearing Adrastus and Amphius of Percote in Asia Minor (τῶν ἦρχῳ Ἄδρηστός τε καὶ Ἄμφιος λινοθώρηξ υἷε δύω Μέροπος Περκωσίου). Earlier in his work, Strabo employs the word in an original context, describing the warriors of Lusitania in

Spain as habitually wearing the linothorax in battle: "Most of them wear linothorakes" (λινοθώρακες οἱ πλείους, 3.3.6).[3] Given his exact quoting of Homer at 13.1.10, Strabo appears to have learned the term from the poet and then applied it to the Lusitanians at 3.3.6. Another notable usage of *linothorax* is found in an oracle given to the Megarians in which the warlike Argives are characterized as "the linothorax-wearing Argives, the goads of war" (Ἀργεῖοι λινοθώρηκες, κέντρα πτολέμοιο, *Anthologia Graeca* 14.73.6). This line forms part of a famous (but possibly spurious) Delphic oracle that was a reply to the question, "Who is the best of the Hellenes?" The oracle occurs in a considerable number of versions in different primary sources, some of which include the reference to the Argives wearing linen armor, and some of which do not.[4] The version that mentions the detail about the linothorax is repeated (in slightly different forms) in at least 10 places by various authors.[5] Finally, the word *linothorax* makes at least seven appearances in ancient lexicons, word lists, and grammatical works, including those of Aelius Herodianus and Hesychius.[6] In all, the word *linothorax* is used 41 times by 14 named authors or commentators and 13 anonymous ones.

The available literary evidence for the existence of this type of armor can be augmented by considering an even larger number of texts that employ the descriptive phrase "a *thorax* made of linen." The ancient Greeks (as well as other ancient Mediterranean civilizations) had the habit of dedicating arms and armor, particularly those seized as spoils during wartime, at temples. Indeed, much of our knowledge of ancient bronze armor is derived from items that have been uncovered by archaeologists digging in these sanctuaries.[7] Unfortunately, the highly perishable nature of fabric means that these excavations have not yielded intact examples of linen cuirasses. From literary sources, however, it is clear that dedications of linen body armor were made at temples and sanctuaries and that linen armor was a common sight at such places.

Herodotus describes in detail two remarkable breastplates made of linen (θώρηκα λίνεον, 2.182, 3.47) that King Amasis of Egypt sent as offerings to Greek temples: one dedicated at the temple of Athena in Lindos and one given to the Lacedaimonians, which was then stolen by the Samians. Because of their elaborate ornamentation and exceptionally fine workmanship, these corselets were regarded as marvels and were also discussed by Pliny the Elder (*Natural History* 19.2) and cited in the *Chronicle of Lindos* (29, lines 36–39). More ordinary (and probably more practical) examples of linen body armor were dedicated at other religious sites. In the treasury of the Carthaginians at Olympia was a set of three linen breastplates, presumably spoils, dedicated by Gelon and the Syracusans after a victory over the Phoenicians (θώρακες λινοῖ τρεῖς, Pausanias 6.19.7). The temple of Apollo at

Gryneion in Asia Minor is attested as having contained multiple linen corselets, although details of the dedicators are not specified (θώρακες λινοῖ, Pausanias 1.21.7). Finally, several "corselets of woven linen" are also listed in the inventory of items dedicated at the sanctuary on the island of Delos (θώρακα ὑφαντὸν λινοῦν, *Inscriptions de Delos*, vol. 3, no. 1403, *Bb*, col. I, line 43).

In addition to temple dedications, mentions of the use of linen armor in the eastern Mediterranean appear in other sources as well. When Xenophon and the 10,000 Greek mercenaries were passing through the territory of the Chalybes in northeast Asia Minor during their epic march, he recorded that these people "wore linen cuirasses reaching to the groin with thickly plaited cords in place of the usual flaps [*pteruges*]" (εἶχον δὲ θώρακας λινοῦς μέχρι τοῦ ἤτρου , ἀντὶ δὲ τῶν πτερύγων σπάρτα πυκνὰ ἐστραμμένα., *Anabasis* 4.7.15–16). In the course of Herodotus's lengthy list of the contingents that made up the Persian army during the invasion of 480 B.C., he includes the Assyrians, whom he characterizes as being equipped "with corselets of linen" (καὶ λινέους θώρηκας, 7.63). Later in the same list, he portrays Phoenician marines as wearing Greek-style helmets and "corselets of linen" (περὶ μὲν τῇσι κεφαλῇσι κυνέας εἶχον ἀγχοτάτω πεποιημένας πρόπον τὸν Ἑλληνικόν, ἐνδεδυκότες δὲ θώρηκας λινέους, 7.89). These references suggest that linen body armor was employed all around the eastern Mediterranean, from Egypt to Phoenicia to Persia to Asia Minor.

For the Greeks of the Archaic and Classical periods, several sources testify to their use of linen corselets. When the poet Alcaeus is enumerating the various arms and armor employed by Greeks in warfare, in the midst of the usual bronze greaves and helmets with horse-hair plumes, he cites "corselets of new linen" (θόρρακές τε νέω λίνω, 2.19).[8] Similarly, in a scene describing the preparations necessary for war, a fragment of Sophocles' play *Epigonoi* includes the line: "And for the wearers of breastplates the weavers are striking up the wise shuttle's songs, that wakes up those who are asleep" (θωρακοφόροισι δ' ὑφαντῆρες, κινοῦσι σοφῆς κερκίδος ὕμνους, *P. Oxy.*, vol. 71, no. 4807).[9] This line from a fifth-century B.C. author clearly links weavers with the production of body armor made out of fabric. Another suggestive passage is found in one of Plato's letters, in which he proposes, "Let us present a hoplite's corselet, one of the soft kind used by foot soldiers" (θώρακα δωρησώμεθα ὁπλιτικὸν τῶν μαλακῶν τῶν πεζῶν,*Epistle* 7.363A). Here, the specification of a "soft" hoplite's corselet plainly indicates that something other than a metal cuirass is intended, although the material in question could be leather rather than fabric. In either case, the soft corselet is obviously a familiar item among the Greeks of this era. At least some of the dedications at Gryneion and Delos were probably from Greeks, although this is not specified. Finally, there are the many repetitions of the

Delphic oracle concerning the "linothorax-wearing Argives" (Ἀργεῖοι λινοθώρηκες, *Palatine Anthology* 14.73.6) previously mentioned.

In the early fourth century B.C., the Athenian general Iphicrates instituted a famous set of military reforms, and among the key changes attributed to him was equipping the soldiers with linen corselets in place of heavier bronze or chain mail body armor (*idem genus loricarum novum instituit et pro sertis atque aeneis linteas dedit*, Cornelius Nepos, *Iphicrates* 1.3–4).[10] These reforms were made expressly for the purpose of increasing the mobility of the troops by giving them armor that was "light but protected the body equally well," in addition to reducing the size of the shield carried. Another reference to the Greeks' use of linen breastplates during the fourth century B.C. is found in the contemporary manual of military strategy written by Aeneas Tacticus, who places "corselets of linen" at the head of a long list of arms and armor to be smuggled into a city and stockpiled when planning an internal coup (θώρακες λίνεοι, *On Siegecraft* 29.4).

From the Hellenistic era, there is evidence that Alexander the Great and the Macedonian army also wore linen body armor. Plutarch offers a detailed list of what Alexander put on while arming for the Battle of Gaugamela, including "a folded (or doubled) linen corselet that had been taken as a spoil at the Battle of Issus" (ἐπὶ δὲ τούτῳ θώρακα διπλοῦν λινοῦν ἐκ τῶν ληφθέντων ἐν Ἰσσῷ, *Alexander* 32.8). One possible interpretation of this passage is that the corselet was that of Darius himself, which he had discarded during his flight after his defeat at Issus.[11] That linen corselets were common Persian armor, at least among the aristocracy, is further attested by a passage in Xenophon's *Cyropaedia*, when Abradatas of Susa is arming for battle and is specifically described as donning a "corselet of linen such as they used in his country" (θώρακα λινοῦν, 6.4.2).[12]

Alexander's possible employment of a captured linen corselet could be dismissed as an exceptional case, but the ordinary Macedonian rank and file may also have worn such armor.[13] While in India, Alexander and his men received a contingent of reinforcements who brought along with them 25,000 new suits of ornately decorated body armor. After distributing these to his men, he ordered that the old armor be burned (Quintus Curtius Rufus 9.3.21). The fact that the old armor was flammable and that it had become worn out, necessitating replacement, shows that it could not have been made of bronze and indicates that it was instead composed of either linen or some other combustible organic material.

A considerable body of visual evidence also testifies to the use of Type IV armor by Alexander and the Macedonians. The most famous of these images is that of Alexander himself in the Alexander Mosaic of Pompeii (plate 2), but a substantial number of Hellenistic sculptural reliefs and tomb paintings also depict Macedo-

nian soldiers wearing Type IV armor. Among the more well known are the soldiers on the Alexander Sarcophagus, the painting of a Macedonian soldier on the facade of the Great Tomb at Lefkadia, a similar figure painted on the wall of a Macedonian tomb under the Bella Tumulus at Vergina, and two warrior figures painted on Tomb III at Agios Athanasios.[14]

Thus, the standard body armor in the Macedonian army, from its commander down to its ordinary soldiers, may well have been the linothorax.[15] Finally, it is suggestive that Alexander's father, Philip II, had spent time as a boy with Iphicrates, the Athenian general to whom the influential switch from metal to linen body armor is generally attributed.[16] If this story is true, Philip would then have had firsthand knowledge of linen armor and its qualities from one of its chief advocates.

There is a somewhat humorous footnote to the use of linen armor by Alexander and the Macedonian army. In the third century A.D., the unbalanced Roman emperor Caracalla, who was a great admirer of Alexander, decided to form a special unit of the Roman army that would emulate Alexander's phalanx. He accordingly dressed up 16,000 men in what he imagined Alexander's army would have worn. In addition to the trademark Macedonian *sarissa*, this equipment included "breastplates made of three-ply linen" (θώραξ λινοῦς τρίμιτος, Cassius Dio 78.7.1–2). This again reinforces the idea that the linothorax was among the stereotypical pieces of equipment of the Macedonian army.

The linen cuirass continued to be used in the armies of the Hellenistic successor kingdoms that followed the reign of Alexander. In a list of items dedicated at the sanctuary on Delos are numerous arms and armor, including "thoraxes of woven linen with golden disks" (θώρακα ὑφαντὸν λινοῦν ἔχοντα χρυσᾶς ἀσπιδισκας, *Inscriptions de Delos*, vol. 3, no. 1403, *Bb*, col. I, line 43). This inscription, which has been dated to between 166 and 155 B.C., is believed to record the inventory of the *neorion*, a shed containing a warship most likely dedicated by Antigonos Gonatos after his naval victory at Kos during the mid-third century B.C.

This armor was not exclusive to the eastern half of the Mediterranean, however. Flax was also grown in Italy, and, not surprisingly, linen body armor is mentioned as having been worn by various early Italic peoples. A linen breastplate is named by Livy as the second *spolia opima* to be dedicated in the Temple of Jupiter Feretrius in Rome after the consul Aulus Cornelius Cossus personally defeated an Etruscan king in the fourth century B.C. (*thorace linteo*, Livy 4.20.1–7).[17] Because the king would presumably have worn the best armor available, this is useful evidence that linen was considered at least comparable to other materials available to the Etruscans for armor, such as bronze.

The Samnites in Italy were major growers of flax and producers of fine linen, to the extent that, when they were beaten by the Romans, one of the terms of the treaty was apparently that they provide garments for every Roman soldier.[18] Livy describes the Samnites appearing for battle arrayed in "shining white linen tunics" (*tunicae . . . argentatis linteae candidae*, 9.40.3), and he also tells of an elite cadre of 16,000 Samnite warriors who were known as "The Linen Legion" (*legio linteata*, 10.38.5–13). Livy's explanation of this term is that the troops mustered and swore their oaths inside a massive enclosure that was roofed over with linen. It is tempting to suggest an alternative derivation for this nickname based on the warriors having been equipped with linen armor, but in the absence of further evidence, this can only remain speculation. In the Hellenistic era, the southern neighbors of the Samnites, the Lucanians, are also attested as having worn cloth body armor. The third-century B.C. epigrammatist Leonidas of Tarentum lists a dedication offered by one Hagnon, son of Euanthes, to Coryphasian Athena consisting of "eight shields, eight helmets, eight woven corselets, and the same number of bloody axes," taken as spoils from the Lucanians (ὀκτὼ ὑφαντοὺς θώρηκας, *Greek Anthology* 6.129).

In Silius Italicus's *Punica*, an account of the Second Punic War, warriors on both sides of the conflict are portrayed as making use of linen armor.[19] On the Carthaginian side, Hannibal's Nubian troops are described as "wearing neither helmet of brass nor rigid cuirass of iron . . . It is their custom to protect their heads with many-layered linen, and with linen to guard their bodies" (*non aerea cassis nec lorica riget ferro . . . tempora multiplici mos est defendere lino et lino munire latus*, Silius Italicus, *Punica* 3.269–272). Later in the work, Crixus, the chieftain of the Boii (a Gallic tribe allied with Hannibal), is referred to as wearing multilayered linen armor; he wreaks havoc at the Battle of Ticinus until he is supposedly slain by a truly heroic spear throw by the young Scipio, which "sped through the many layers of linen and through the shield made of hide" (*fugit illa per oras multiplicis lini subtextaque tegmina nervis*, Silius Italicus, *Punica* 4.290–91). Sculptural reliefs in Africa suggest that the linothorax may have been standard equipment among Hannibal's native Carthaginian soldiers as well, and the characteristics of this armor (discussed in chapter 7) would certainly have made it appropriate gear for desert warriors.

There may be a third contingent of Hannibal's army equipped with linen armor mentioned by Silius Italicus in the same list, but the passage is somewhat ambiguous. When enumerating the Spanish allies of Hannibal, Italicus notes that "conspicuous among these due to the brightness of their corselets were the Sedentanian soldiers, who came from the icy waters of the Sucro and the lofty citadel of their mother city, Saetabis—Saetabis which dares to despise the looms of the Arabs

and to match her webs against the linen of Egypt" (*hos inter clara thoracis luce nitebat Sedentana cohors, quam Sucro rigentibus undis atque altrix celsa mittebat Saetabis arce—Saetabis et telas Arabum sprevisse superba et Pelusiaco filum componere lino*, Silius Italicus, *Punica* 3.371–75). While the shining quality of the armor of the Sedentanians could easily be from polished metal rather than linen, the author's immediate emphasis on their pride in the especially fine linen that they produce is suggestive. Pliny the Elder also singles out Saetabis as being the source of particularly high-quality linen (*Natural History* 19.1–2). That Spanish tribes such as these did employ linen body armor is incontestably confirmed by other authors. For example, as noted, Strabo states that the linothorax was the favored type of armor of the Lusitanians (3.3.6). Thus, the attested use of this armor can be extended to the very westernmost edge of the Mediterranean.

Silius Italicus also portrays linen body armor being used by various groups within the Roman army opposing Hannibal. He reports that the contingent of soldiers from Falerii was clad in linen armor and that this material was a native product of the Faliscan region (*indutosque simul gentilia lina Faliscos*, *Punica* 4.223). Later, during the Battle of Cannae, a Roman named Tadius is graphically described being gored by a Carthaginian elephant that has blades attached to its tusks. The poet relates how Tadius's "corselet with its many layers of linen" protected him long enough, while the blade slowly bored through each stratum of the armor, for him to plunge his sword into the elephant's eyes (*qua tegmine thorax multiplicis lini claudit latus*, *Punica* 9.586–98). While there are dubious aspects to this account, it does at least reiterate the main point that linen body armor was both a widely known and a credible form of protection during this conflict.

The later Roman army of the imperial period does not seem to have favored linen body armor, but such armor was certainly not unknown during these times. In addition to the linen armor found among Caracalla's anachronistic "Macedonian Legion," the emperor Galba was reported to have donned a linen cuirass (*loricam linteam*, Suetonius, *Galba* 19.1) when worried about being ambushed by assassins. In his treatise on training cavalry, the experienced second-century A.D. Roman military commander Arrian states that "armored horsemen wear corselets of scales, or linen, or horn" (*Tactica* 4.1). From Pausanius, we hear that at his time (second century A.D.) "breastplates of linen" were popular among hunters because they were supposedly good at catching and breaking the teeth of dangerous wild animals such as lions and leopards (θώρακες οἱ λινοῖ, 1.21.7).

Altogether, then, there are some 65 distinct references by more than 40 different ancient authors that explicitly testify to the existence of a type of body armor made of linen.[20] The range—geographic, cultural, and temporal—of this list of citations

is truly remarkable. They span the entire geographic extent of the ancient Mediterranean world from the ancient Near East to the Iberian Peninsula, and among the peoples represented are the Egyptians, Assyrians, Phoenicians, Persians, Greeks, Macedonians, Chalybes, Etruscans, Samnites, Romans, Nubians, and Lusitanians. If one accepts as accurate Homer's contention that such armor was in use at the notional time of the Trojan War, then chronologically, these citations encompass nearly 1,500 years. Even if one prefers to consider only the more firmly attested cultures, such armor was plainly in widespread use from at least the sixth century B.C. through the first century A.D. Additionally, this list includes both civilizations that were extremely wealthy and cosmopolitan and ones that were impoverished and provincial. It is also interesting that linen seems to have been regarded as appropriate body armor for many different types of troops, from skirmishers to heavy infantry, and even some kings and aristocrats are said to have favored it. Thus, the linothorax appears to have been a piece of armor that was available to, and deemed a desirable form of protection by, an enormously broad range of civilizations of vastly differing levels of material culture and wealth, and in a wide variety of military contexts.

These literary descriptions of ancient linen armor have not always received full consideration from military historians and, as far as we know, have never before been gathered together. The one exception to this lack of attention is, rather unfortunately, what are probably the most atypical examples of such armor: the dedications of King Amasis of Egypt. These two corselets, portrayed as being adorned with ornate embroidery, were regarded as tourists' marvels because each thread was apparently composed of 360 separate strands. Every few decades, these suits of armor and their peculiar construction are the focus of a short article that attempts to make sense of Herodotus's description, and the unusual qualities of these two corselets have intensified the confusion surrounding linen armor in general.[21] This is particularly regrettable because we believe that these two corselets are obviously completely atypical examples, which were commissioned by royalty out of rare materials for a specific purpose, and whose characteristics cannot be used in any way as a reliable guide to the construction and qualities of more everyday (and battlefield-functional) suits of linen armor. Nevertheless, because, for better or worse, these are the most famous examples of this armor in scholarship, some additional discussion of them is merited.

Herodotus's complete description of these two corselets is as follows: "Moreover Amasis dedicated offerings in Hellas . . . to Athena of Lindos two stone images and a marvelous linen breastplate" (Ἀνέθηκε δὲ καὶ ἀναθήματα ὁ Ἄμασις ἐς τὴν Ἑλλάδα . . . τοῦτο δὲ τῇ ἐν Λίνδῳ Ἀθηναίῃ δύο τε ἀγάλματα λίθινα

καὶ θώρηκα λίνεον ἀξιοθέητον, Herodotus 2.182); "this breastplate had been stolen away by the Samians in the year before they took the bowl; it was of linen, decked with gold and cotton embroidery, and interwoven with many living figures; but what makes the wonder of it is each individual thread, for fine as each thread is, it is made up of three hundred and sixty strands, each plainly seen. It is the exact counterpart of that one which Amasis dedicated to Athena at Lindos" (καὶ γὰρ θώρηκα ἐλκίσαντο τῷ προτέρῳ ἔτεϊ ἢ τὸν κρητῆρα οἱ Σάμιοι, ἐόντα μὲν λίνεον καὶ ζῴων ἐνυφασμένων συχνῶν, κεκοσμημένον δὲ χρυσῷ καὶ εἰρίοισι ἀπὸ ξύλου. τῶν δὲ εἵνεκα θωμάσαι ἄξιον ἀρπεδόνη ἑκάστη τοῦ θώρηκος ποιέει. ἐοῦσα γὰρ λεπτὴ ἔχει ἀρπεδόνας ἐν ἑωυτῇ τριηκοσίας καὶ ἑξήκοντα, πάσας φανεράς. τοιοῦτος ἕτερος ἐστὶ καὶ τὸν ἐν Λίνδῳ ἀνεθηκε τῇ Ἀθηναίῃ Ἄμασις, Herodotus 3.47).

In addition to Herodotus's account, the dedicatory linen corselet at Lindos is also described in the *Chronicle of Lindos* (29, lines 36–39), which emphasizes the detail that each thread was made of 360 strands: "Amasis, king of the Egyptians, a linen corselet, of which each thread had 360 strands. About which Herodotus the Thurian testifies in the second book of his *Histories* . . ." (Ἄμασισ Αἰγυπτίων βασιλεὺς θώρακα λίνεον, οὗ ἑκάστα ἀρπεδόνα εἶχε στάμονας ΤΧ, περὶ οὗ μαρτυρεῖ Ἡρόδοτος ὁ Θούριος ἐν τᾶι Β τᾶν ἱστοριᾶν . . .).

While the claim of the strand count per thread has often been accepted at face value, it seems rather improbable. It is perhaps more likely that the number is either exaggerated or refers to some ancient equivalent of thread count per square area. It is also possible that these particular corselets really were composed of exceptionally thick threads that were constructed so as to contain hundreds of individual strands twisted together. The most recent study of these corselets (Moxon 2000) favors this interpretation and argues that they were crafted as an elaborate symbolic homage to Athena and her aegis. In any event, they were plainly intended as showpieces rather than practical armor. Also, the fact that the number of threads is conveniently the same as the number of days in the Egyptian year either raises doubts about the veracity of the tale or further indicates that these corselets were specially created in order to conform to purely symbolic considerations. When Pliny the Elder mentions the corselet, he attributes 365 (rather than 360) strands to each thread, which correspond to the number of days in the Roman calendar, suggesting that these corselets had become known as "those whose number of strands per thread is equal to the number of days in the year." Whatever the precise meaning of these passages, plainly the original intent of the dedications was to impress viewers with the exceptionally atypical qualities of the fabric and the skillfulness of the weavers.[22] Pliny the Elder adds that the corselet at Lindos apparently still

existed in the first century A.D., although in a much tattered form, as the result of damage inflicted by curious tourists who had attempted to count the number of threads for themselves (Pliny, *Natural History* 19.2).[23] The exact construction of these breastplates will likely remain a mystery. Unfortunately, the very uniqueness that made them such touristic marvels also probably renders them less than helpful when it comes to reconstructing the more ordinary and practical linen body armor that was worn on ancient battlefields.

Linen in the Ancient World

This image of the widespread use of linen armor offered by the primary sources is reinforced by the availability of linen across a similarly vast geographic range, due not only to trade but also to the natural range of the flax plant (*Linum usitatissimum*).[24] The most elaborate treatment of the flax plant by an ancient author is found in Pliny the Elder's *Natural History*. Pliny stresses the ease of growing it and its adaptability to unpromising agricultural environments: "No plant grows more easily than flax," and "no other plant grows more quickly," he states (19.1.6; 19.2.7). He also notes that it readily grows in sandy soils and requires only a single plowing. Thus flax can be grown on land that is marginal or unsuitable for other types of agriculture, and, adding to its versatility, flax even grows well at higher altitudes. It does, however, require a fair supply of water and was believed to deplete the soil. Pliny identifies several areas in Italy that he claims produce especially fine or sturdy linen: among them, the vicinity of Faventia, near Cumae; around Retovium; and the highland territory of the Paeligni. Other notable producers of fine linen were sites in Spain, such as Saetabis, Tarraconensis, and Zoelae. In passing, Pliny mentions other regions where flax is grown, including Egypt, Greece, Gaul, and even Germany (19.1–2).[25]

Linen has been one of the most widely used textiles by humans and, arguably, is the oldest, with definitive finds from Israel, Anatolia, and Syria dating to at least 6000 B.C. Asia Minor and Egypt were famous throughout historical antiquity as producers of linen, and fragments of linen found in archaeological excavations attest to its manufacture in northern Italy as early as the third millennium B.C. Linen was widely used in Greece at least by Mycenaean times. It was a versatile fabric, employed not only for all kinds of clothing but also for awnings, packaging, sails, tents, paintings, and bandages, among other known uses. Like all fabrics in the ancient world, linen was time-consuming to produce, but it had many qualities that rendered it an attractive textile, including that it dries quickly, is very breathable, has

high tensile strength, possesses low elasticity, exhibits good durability, and becomes stronger when wet.

The ancient process of making linen from flax was complicated and labor-intensive.[26] Once grown, flax plants were not cut but instead were pulled from the soil. Seeds were removed by a procedure known as rippling, in which a large, wooden, comblike instrument was employed to separate the seeds from the stems. The desirable fibers from which linen is eventually formed, known as bast fibers, run vertically in bundles within the flax plant's stems. The bast fibers are encased in a matrix of pectinous gums and waxes situated between a hard outer cuticle, or casing, and a woody core and must be separated out from these other components in order to be useful. A typical stem contains approximately 15–30 fiber bundles, and each of these in turn contains 10–40 individual fibers that can be as much as 60 cm in length.

To extract the bast fibers, it is necessary to break down the pectinous matrix in which they are held. This was accomplished through a process known as retting, which can be done quickly by immersion in water, or more slowly over several weeks, through a procedure known as dew retting. Once retted, the stems were dried and then smashed with mallets to split apart the individual components in a procedure known as breaking and scutching. After the desirable fibers had been crudely removed from the outer cover and the core, they were hackled (or combed), normally by drawing the fibers across a board equipped with spikes. The result was a hank of thin fibers that were remarkably similar in appearance and texture to dirty-blonde human hair. Hackling completed the processing stage, and the fibers were then ready to be spun into thread.

We purchased most of the linen we used in our experiments from traditional weavers who grew the flax, processed it, spun the fibers, and wove it into linen using the traditional methods described here. Currently a faculty-student project is underway at our university under the direction of Profs. Alison Gates and Heidi Sherman to plant and harvest several fields of flax, then process it by the traditional methods described above, spin the resultant fibers into thread, and weave it into linen. The first such crop was grown, harvested, and processed in 2011. Hopefully, once we have a sufficient number of students trained in traditional processing, spinning, and weaving techniques, in the future, we will be able to use linen that has been entirely produced by ourselves.

To form thread, the raw fibers were twisted together, typically using a drop spindle. Depending on which direction the spindle is rotated, the resulting thread has a characteristic appearance visible in the twists, which inspires the following

descriptive terms: Z-spun if the spindle was rotated clockwise and S-spun if the spindle was rotated counterclockwise. In ancient Egypt, the Near East, and Iberia, S-spun thread seems to have dominated, whereas Z-spun was more popular throughout most of Europe. Later, the drop spindle would be replaced by the spinning jenny and eventually even more automated processes, but in antiquity, spinning the fibers into thread would have been by far the most time-consuming phase of production. A crude rule of thumb is that it required about 10 spinners to keep one weaver employed.

The final stage of this process, weaving, usually took place on a frame known as a loom.[27] The thread was transformed into fabric by creating a static system of parallel threads on the loom through which another set of threads was interwoven at right angles. The static set of threads is called the warp, while the movable ones constitute the weft. The simplest form of weaving consists of pulling the weft threads alternately over and under successive warp threads, producing a pattern called plain tabby. More complex woven patterns, such as twills, can be created by interweaving the warp and weft threads in different arrangements.

Linen cloth naturally ranges in color from shades of dirty gray to brown, but it can be bleached to varying degrees of whiteness by several different methods, such as rubbing it with natron or potash and then subjecting it to rinsing, beating, and bleaching in the sun.[28] Because of the nature of its fibers, linen shakes off dirt and dust particularly easily but also is especially resistant to dyeing.

Visual Sources

While the literary sources testify that there was a commonly used type of ancient armor made out of linen and that linen itself was readily available across the ancient Mediterranean, these authors were not particularly helpful in our attempt to reconstruct what this armor looked like and to determine how it was actually made. In this regard, the second and more numerous type of source for the linothorax, iconographic depictions, proved to be especially important. Such images fall into two main categories: vase and wall paintings; and sculptures in stone, metal, and terracotta. In all these forms of visual media, there are numerous examples that show ancient warriors wearing the distinctive body armor that has been labeled Type IV. Particularly enlightening in understanding how it looked and functioned are a number of images that show soldiers in various stages of putting on this armor (fig. 1.1).[29]

One topic that merits consideration when employing a body of visual evidence such as the database listed in the appendix is the degree to which artistic representations of an ancient object, in this case Type IV armor, can be taken as reproducing

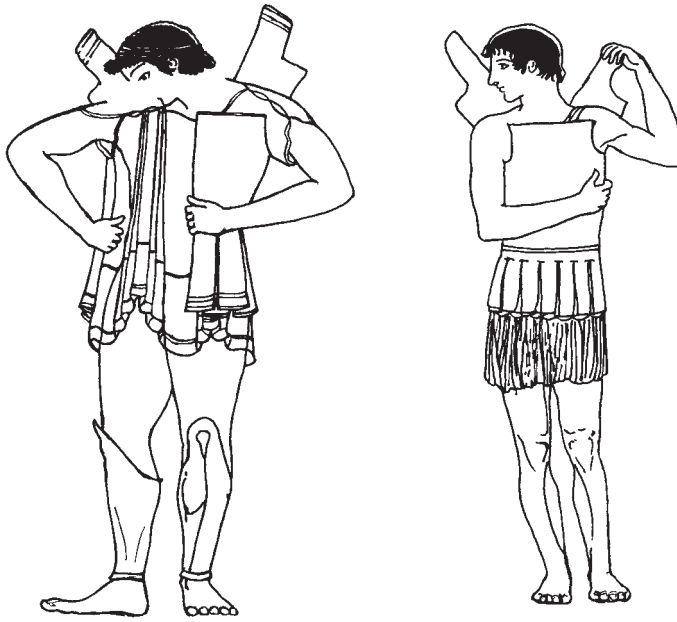

Fig. 1.1. Arming scenes from red-figure pots. Note how the warriors are wrapping the armor around their torsos, and the shoulder flaps are sticking upright before being tied down. (*Left*, R-26; *right*, R-183)

historical reality. Some potentially problematic questions immediately come to mind. When a painter or sculptor created an image of Type IV armor, how concerned was he with capturing an accurate image of what such armor looked like? To what degree did aesthetic or narrative concerns or conventions affect his portrayal? When illustrating a subject from the mythical or historical past, such as the Trojan War, was the artist attempting to realistically depict what he believed equipment looked like at that time or was he showing the figures wearing contemporary armor? How much simplification took place because the artist was working on a small scale? How much did any given artist know about military equipment in the first place? In scholarly discussions of ancient warfare, there is often surprisingly little analysis of such fundamental issues.[30] Of course, this is partly because the general dearth of evidence surviving from the ancient world makes any bit of surviving information valuable, and in the absence of more complete records, all we can do is focus on what is available.

When it comes to the depiction of Type IV armor, several key factors can help to increase our confidence in the relative accuracy of the visual evidence. The most

important of these is the remarkable consistency in the way that the basic features of the armor are depicted. This consistency spans multiple categories: artist, medium, time period, culture, and place. Thus, the way that the basic form and characteristics of Type IV armor are sculpted by a third-century B.C. Etruscan artist working in three-dimensional terracotta is amazingly consistent with and similar to the manner in which a sixth-century B.C. Attic vase painter illustrates them, and both are nearly identical to the way a Persian artist chose to engrave an image of a hoplite on a cylinder seal. Such consistency across widely disparate times, places, and makers strongly argues both for the widespread use of the armor and for the accuracy of the artistic portrayals of its fundamental characteristics. Whereas it would be speculative to draw conclusions based on any single depiction of Type IV armor because of the potential for inaccuracies introduced owing to specific cultural, aesthetic, or other concerns of the individual creating the image, deductions that are founded upon the entire body of visual evidence possess much greater reliability.

A similar argument can be made based on the comparison of images of Type IV armor rendered in different degrees of detail. If, for example, we compare the extremely crude depiction of Type IV armor found on some black-figure vases in which the armor is drawn with just a few strokes on warriors who are little more than stick figures with such highly detailed renditions of it as appear on some intricately inscribed large, bronze Etruscan statuettes or on the life-size painted relief on the Aristion stele, we find a consistent portrait of the same armor. One image may contain far more detail than the other, but the basic forms and elements are identical.

Finally, assurance of the basic accuracy of artistic representations of military equipment can be derived from the instances in which items of arms and armor survive and can thus be directly compared with contemporary depictions of the same equipment by artists. So, for example, the bronze helmets, greaves, breastplates, shields, and other paraphernalia from sites such as Olympia correspond closely to the images of these same items appearing on vase paintings and in sculpture that date to the same period as the dedications themselves. This in turn suggests that the representations of pieces of equipment that have not survived, such as Type IV armor, offer a similar degree of accuracy in their portrayal of these items.[31]

From this large body of visual material, therefore, it has been possible to identify the main characteristics of the armor and how it was worn. The diagnostic features of this armor are that it seems to have had two main components: a long, rectangular piece that wraps around the body, forming a kind of tube enclosing the wearer's torso, and an H-shaped section that goes over the shoulders. To put his armor on, a soldier first bends the rectangular piece around his torso, and then

secures it by lacing together the two ends, usually on the left side (fig. 1.1 and plate 1). Often the two ends overlap to a greater or lesser degree, and in some rare instances, they are laced together in front. Affixed to this main part of the armor is the separate H-shaped shoulder section, which is permanently attached to the tube section in the region of the upper back.[32] The two unattached strips (*epomides*) of the H-shaped piece are then pulled forward, with one strip on each side of the head, and both are tied down on the upper chest. From the bottom of the tubular section hangs a single or double row of flaps (*pteruges*), which offer some protection to the groin and upper thighs.

The sheer volume of images of this distinctive Type IV armor is impressive. The appendix contains a comprehensive list of all the ancient visual depictions of Type IV armor that we have been able to identify. Although authors such as Hagemann (1919), Anderson (1970), and Jarva (1995) cite some specific visual examples, no comprehensive list of images of Type IV armor has ever previously been published.[33] Because this evidence is vital to understanding the armor, we accordingly undertook the task of assembling the database in the appendix. While we cannot pretend that it is comprehensive and, indeed, are constantly finding additional examples, we hope that it will serve as a useful resource and starting point for other scholars.

This database was compiled from many sources. We began by going through the more than 200 printed volumes of the *Corpus Vasorum Antiquorum*, supplemented by searching through its online counterpart (http://www.cvaonline.org/cva/ProjectPages/CVA1.htm). In addition, we collected examples by looking through museum and exhibit catalogs and standard texts on various specific types of ancient art, such as A. Andrén's *Architectural Terracottas from Etrusco-Italic Temples* (1939, 1940). We added images referenced in other publications on ancient armor, such as Jarva (1995) and Polito (1998), and augmented these with further instances observed during personal visits to museums across Europe and the United States.

One problematic issue was how to organize the database of images. We considered various possibilities, including chronology, current location, region of original discovery, and the culture that produced the object. For each of these categories, however, there would have been obvious problems of labeling individual works with any degree of certainty, and for numerous examples, whatever date or provenance we ultimately assigned would have been hotly contested by other scholars.

We therefore settled on first simply organizing the catalog of images into broad categories by the medium on which the image appears: black-figure vase, white-ground technique vase, red-figure vase, stone sculpture, metal object, terracotta sculpture, and painted image. Then, within each category, we organized the

objects chronologically (as much as it was possible to do so), while acknowledging that many of the dates or date ranges were approximate or contested. While obviously not entirely satisfactory, this organizational scheme at least has the merit of being clear and simple in its categorization.[34]

Objects are labeled with a letter and a number. The letter represents the type of object according to the following scheme: B = Black-Figure Vase; R = Red-Figure Vase; W = White-Ground Technique Vase; S = Stone Sculpture; T = Terracotta Sculpture; M = Metal Object; P = Painted Image. The number represents its estimated place in the chronological sequence of objects of that type. Thus, for example, "R-1" would designate the earliest red-figure vase bearing an image of Type IV armor.

At the time of writing, we have identified 913 individual images of Type IV armor on 486 different objects or items. These images fall into the following general categories:

— Black-figure vases: 96 total images, 48 items
— White-ground technique vases: 12 total images, 12 items
— Red-figure vases: 464 total images, 249 items
— Stone sculptures/reliefs: 115 total images, 62 items
— Terracotta sculptures/reliefs: 41 total images, 25 items
— Metal objects: 158 total images, 80 items
— Paintings: 27 total images, 10 items

In chronological terms, the earliest images date to around 600 B.C. and the latest are from the first century A.D., a range that corresponds well to the literary attestations. Most of the black-figure images fall between 575 and 475 B.C., the white-ground from around 500 to 425 B.C., and the red-figure from roughly 525 to 350 B.C. The images from both the stone and terracotta sculptures span a wide chronological range from the sixth century to the first century B.C., with a significant number of reliefs dating to the Hellenistic era. Most of the images on bronze are from Etruscan cists, mirrors, and statuettes and range from around 500 to 200 B.C. The paintings are from either Etruscan or Hellenistic tombs and span approximately 400 to 200 B.C.

While depictions of Type IV armor are found on an impressive array of different types of objects, from Etruscan bronze mirrors to pedimental temple sculptures, by far the largest general category is ceramic vases, which account for nearly two-thirds of the total number of images (572 of 913). Within this group, depictions on red-figure vases are the most common, accounting for just over half of all images (464 of 913). As for geographic origin, the majority of the objects in this database

were found on mainland Greece, with a substantial number of items also deriving from Greek and Hellenistic cities and sites of the Aegean and Asia Minor. The largest distinct ethnographic subgroup is the images on Etruscan objects, which constitute approximately 25% of the total. Finally, there is a very small scattering of objects from various other sites around the Mediterranean region. There is even at least one depiction of a Greek hoplite wearing a Type IV corselet on a Persian cylinder seal from the early fifth century B.C., suggesting that the Persian artist viewed this as typical Greek body armor at that time.[35]

As might be expected, the most common subject matter is illustrations of stories from Greek mythology, especially incidents from the Trojan War. While non-Greek figures, especially Amazons, are sometimes shown wearing Type IV cuirasses, clearly identifiable and even labeled Greeks, such as Achilles, are far more often portrayed in this armor.[36] Interestingly, the lesser Ajax, the one mythological character who is specifically described in a literary source as having worn a linothorax and who also is clearly identifiable in visual images, is indeed usually shown wearing Type IV armor.[37] Other frequently occurring settings for the visual images of Type IV armor are generic historical subjects, such as warriors leaving home or preparing for battle. A few, such as the Alexander Mosaic, depict an identifiable historical figure wearing the armor.[38]

In the overwhelming majority of cases, Type IV armor is portrayed as apparently being made of a single material, but 22% of the images (201 of 913) show part or all of the basic armor as being covered with some sort of additional protection in the form of applied scales.[39] Other interesting subsets include 18 images in which warriors are in the process of putting on the armor, 5 in which it is being carried, and 42 of riders on horseback wearing this type of armor.

How Type IV armor fits into the chronology of Greek armor development has been the subject of much speculation. The traditional time line for metal Greek body armor has held that the bell cuirass (Type I) appeared around 750 B.C. and remained in use until the fifth century B.C., when it was replaced by the muscle cuirass (Type III), which continued to be employed, at least by wealthier warriors, into the Hellenistic era. On the basis of the iconographic evidence, most scholars propose that the composite cuirass (Type IV) began to be widely used in Greece in the mid- to late sixth century B.C., becoming the dominant form over metal body armor by the early fifth century B.C., and then continuing in use throughout the Hellenistic era.[40] Some argue for a further refinement in which the Type IV armor, modeled after Near Eastern or Egyptian models, was initially made mostly from linen but then by the third century B.C. was superseded in prevalence (at least in Greece) by leather versions. Furthermore, some view the linen corselet as a rare or

unknown item in Greece until some key event, such as the donations of Amasis or the Persian Wars, "exposed" the Greeks to it and inspired them to imitate it themselves.[41]

We believe that, as the literary evidence indicates, forms of linen body armor were relatively common and well known across the entire Mediterranean from an early date. If one accepts that Type IV armor was made of linen, then certainly the growing prevalence of Type IV armor on vase paintings starting around 550 B.C. suggests that it became a much more frequently encountered means of protection in Greece over the next half century, perhaps eventually becoming the dominant form of body armor. Even before this period, however, we believe that it was not an unfamiliar item to the Greeks. Rather than some key event sparking the introduction of the linen corselet, we think that it was always one possible option for protection among ancient warriors.

Such an interpretation is reinforced by the fact that vase paintings often show a mixture of different types of armor being worn by warriors of the same nationality in the same scene. Thus, in a fifth-century B.C. depiction of an episode from the Trojan War, one Greek warrior may be illustrated wearing Type IV armor while another has a muscle cuirass. Some scholars have interpreted these distinctions in armor as being indicative of differences in status among individual soldiers.[42] While it might be viable to propose such an interpretation for a single pot, there is no overall, consistent, discernible trend. In terms of what warriors actually wore, stylistic, economic, or military concerns may have made Type IV armor more or less popular at various points and places, but the evidence indicates that it was widely employed over a long period and in many regions, as at least one among several potential types of armor.

An interesting related question is whether the Type IV version of the linen corselet, with its distinctive shoulder flaps and laminated construction, is the same as the linothorax mentioned by Homer or even early Archaic versions of linen armor. While there seems to have been continuity in the use of linen to make body armor from at least the seventh century B.C. onward, whether the earlier versions were the same in form and construction as those seen in the later vase paintings cannot be known for certain.

A range of ancient authors definitively asserts that linen armor was employed across the Mediterranean by a wide variety of cultures. The visual evidence indicates that armor of the Type IV design was the most common type (or at least one of the most common types) of armor worn by Greek warriors, especially from the sixth through the third century B.C. Taken together, the literary and visual evidence offers a persuasive case for the long-standing and widespread use of linen

body armor. Before this conclusion can be fully accepted, however, one assumption in this chain of logic should be examined in greater detail: that Type IV armor was composed primarily of linen. Is it possible that Type IV armor was made out of some other material? This question is explored in chapter 3. Before we pursue this line of inquiry, chapter 2 uses the database to identify the main structural variations of Type IV armor, as well as stylistic tendencies in the way that this armor was constructed and decorated.

Structural Variants and Decorations on Type IV Armor

Amassing the database of visual examples of Type IV armor has allowed a more precise analysis of certain characteristics of this sort of ancient armor, which until now has been approached only in an impressionistic manner. The database enables us to examine the painted and applied decorations depicted on the armor in a systematic way and to determine how common certain ornamental designs were. Similarly, it allows analysis of variations in the structural characteristics of the armor, such as the shape of the shoulder flaps or the arrangement of the *pteruges*. By noting changes in decoration and structure, we can detect patterns in preferred styles over time.

Other than impressionistic comments in books on ancient warfare, decorative aspects of ancient armor have rarely received rigorous scholarly attention. A notable feature of Type IV armor is the greatly varying degree of decoration and the fluctuations in certain structural details that are revealed in the visual examples. As the vase paintings in particular suggest, this style of armor was highly customizable and varied from the very plain to the wildly elaborate, depending perhaps on the socioeconomic status of its wearer. These variations include some elements that were clearly intended for protective purposes and others that were simply decorative.[1] By analyzing the depictions of Type IV armor that occur in the vase paintings, frescoes, and sculptures collected in our database, we can discover the most popular design choices a warrior might make from the late Archaic through the Hellenistic periods, especially the late sixth through the fifth century B.C, the period for which the most visual evidence survives.

By date, just over one-fifth of the artistic representations derive from the sixth century B.C., a bit more than two-fifths from the fifth century B.C., and about one-fifth from the fourth century B.C. and later. Of the sixth- and fifth-century B.C. images, most appear on ceramic vases, whereas the Hellenistic images are almost all from stone reliefs, metal objects, or paintings. Because the representations on vases tend to be much clearer than those sculpted in stone or painted, which are often eroded or worn, this chapter focuses mainly on the evidence

from vase painting, with occasional supplementation from the other forms of media. Consequently, the following analysis is most relevant for the fifth century B.C.

Structural Elements I: Shoulder Flaps

Perhaps the most visually distinctive feature of Type IV armor is the shoulder flaps that wrap around either side of the wearer's neck and then are bent over in order to fasten them down onto the front of the torso using a set of ties. Although these differ slightly from one corselet to the next, there are two basic styles: those in which the ends of the arms are squared off[2] and those in which the ends of the arms are rounded[3] (fig. 2.1). For the rounded style, there are two subvariants: those that are rounded on a single edge of the flaps' ends and those that are rounded on both edges (with the former being far more common).

Early on, the squared-off end design seems to have been more prevalent. Of all the examples of armor with squared flaps that are clearly identifiable in the visual

Fig. 2.1. Typical linothorakes illustrating square shoulder flaps (*left*) and rounded shoulder flaps (*right*) from red-figure vases. (*Left*, R-218; *right*, R-186)

evidence, fully one-third date to the 50-year period from 525 B.C to 475 B.C., with the rest scattered evenly over the much longer era from 475 to 300 B.C. Thus, squared flaps appear to have fallen out of popularity around the time of the Persian Wars. Persian soldiers are often shown wearing rounded shoulder flaps in Greek artistic representations,[4] so it is possible that the Greeks adopted the design after coming into contact with Persian soldiers at Eretria or Marathon. However, Persians are also depicted with squared flaps, and the chronological correlation is not strong enough to identify a clear trend in this regard.[5]

The rounded or curved type correspondingly gained popularity around the same time that the squared shoulder flap declined. Examples increased dramatically from the first half of the fifth century B.C., with around 75% of the shoulder flaps identifiable on the vase paintings over that 50-year span, and this type continued to be dominant through the last quarter of the fifth century B.C. (c. 425–400 B.C.). Of all shoulder flaps identified from every period, the rounded type makes up about three-fifths of the total.

Structural Elements II: Shoulder Flap Ties

The shoulder flaps on Type IV armor were fastened to the torso by a set of ties, probably made of leather strips or heavy cord. Despite their obvious importance, they are depicted in only about half of the visual representations. Although the shoulder flaps may have been fastened to the torso in some way other than by ties, there is no evidence for this. Therefore, the omission of ties in the images should most likely be interpreted not as a variant form of the armor but rather as a deliberate simplification by the artist.[6]

The images indicate that there were three main methods for attaching the shoulder flaps:[7] using a single, central attachment point on the torso to which individual ties extend from each shoulder flap, forming a V-shape (fig. 2.2, left);[8] by a parallel double-attachment point system in which individual ties extend from both shoulder flaps, running parallel with one another, and are fastened to separate attachment points on the torso (fig. 2.2, right);[9] and by a crossed-over double-attachment system in which individual ties extend from each shoulder-flap, cross over one another forming an X-shape over the torso, and are secured to two attachment points (fig. 2.3, left).[10] A fourth attachment point style that combined elements of the others also existed in which the ties ran down from each shoulder flap to two points on the chest (possibly wrapping around them) and then were brought together at a single central point lower down (fig. 2.3, right).[11]

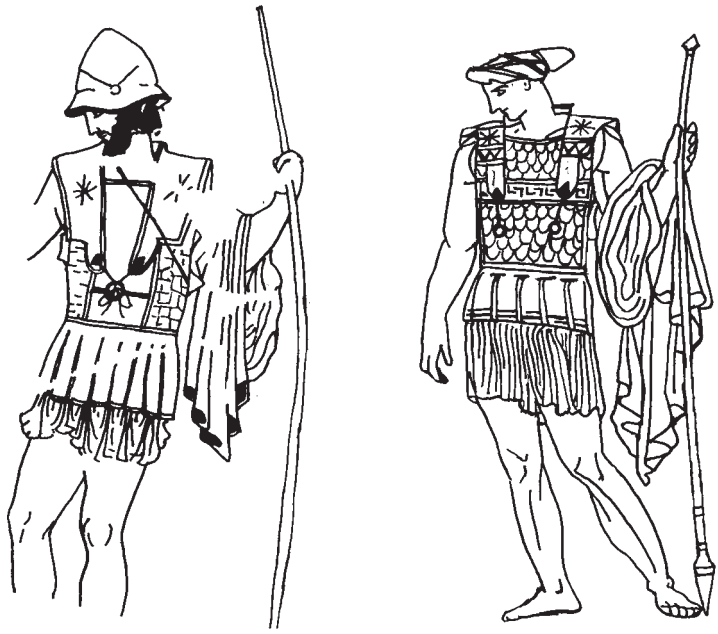

Fig. 2.2. Warrior with central attachment point for shoulder flap ties (*left*), and Amazon with parallel attachment points (*right*). Note the rounded scales on the Amazon. (*Left*, R-140; *right*, R-229)

There does not appear to have been a pronounced pattern in terms of one style being favored over another in any particular period, nor is there a definable development from one method of attachment to another. There were, however, overall favorites among the various attachment methods in terms of sheer numbers. By far the most common was the single-attachment point; it accounted for more than three-quarters of the examples in which ties were visible. The crossed-over double-attachment point and parallel double-attachment point methods each accounted for less than 10% of the examples. The parallel double-attachment point style seemed especially popular among Hellenistic depictions of Type IV armor. Finally, the rarest form, the combination style, was found on only a handful of images. Many of the shoulder flaps had circular rings, presumably made of metal, through which the ties were inserted and then fastened to matching rings located on the torso (fig. 2.4, left).[12] On armor with the single-attachment point method, what looks like an odd wheel-like device, located in the center of the torso, was sometimes used to secure the ties (fig. 2.4, right).[13] Most likely this was simply a large knoblike

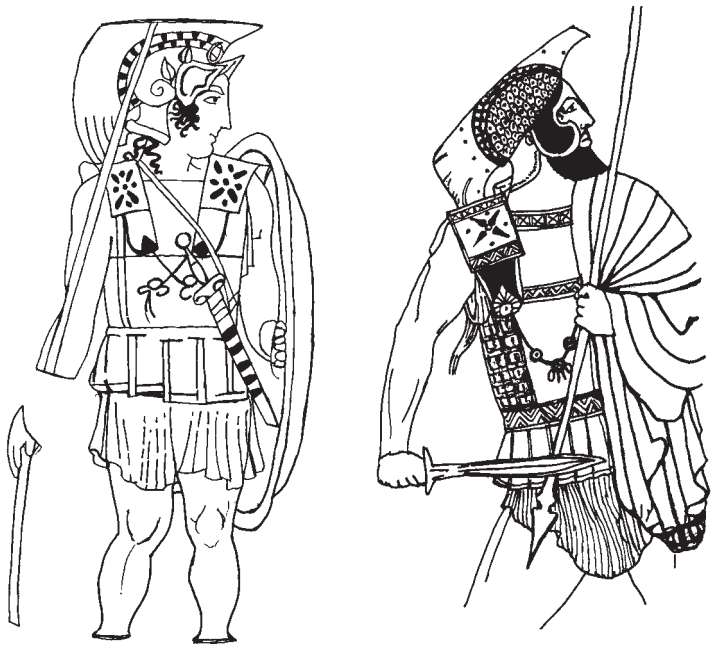

Fig. 2.3. Red-figure vase depiction of Achilles with crossed-over attachment point method (*left*), and warrior with combination attachment method (*right*). Note the decorative stars on the shoulder flaps of both figures. (*Left*, R-213; *right*, R-185)

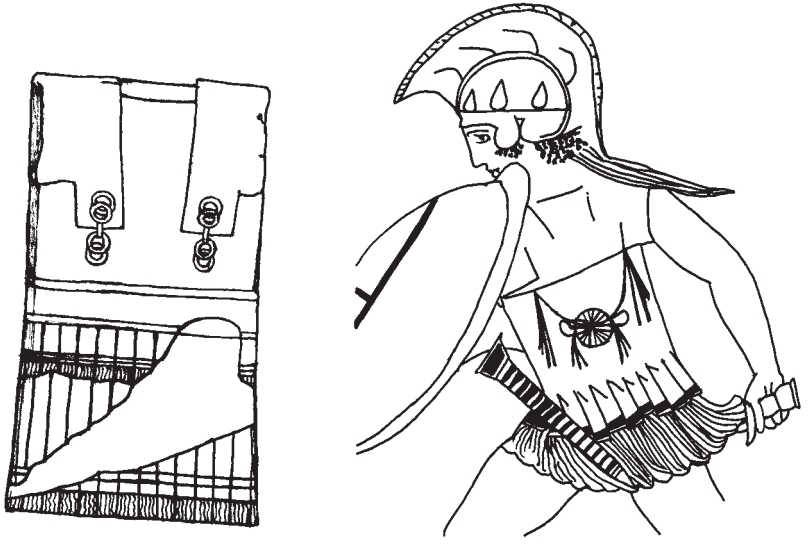

Fig. 2.4. Stone relief from Tunisia showing attachment rings for securing the shoulder flaps (*left*), and warrior from red-figure vase with "wheel-like" device used as attachment point for shoulder flaps (*right*). (*Left*, S-47; *right*, R-193)

feature affixed to the chest around which the cords could be wound or tied, but the images lack sufficient detail to determine the nature of its construction.

Structural Elements III: *Pteruges*

The number of rows of *pteruges* (always either one or two) that were present on Type IV armor underwent a noticeable shift over time similar to that seen in the shape of the shoulder flaps. Two rows of *pteruges* were more common in the earlier periods (fig. 2.5), from the mid-sixth to the first quarter of the fifth century B.C. (550–475 B.C.).[14] After 475 B.C., however, double rows disappear almost completely from artistic representations, particularly on vase paintings. From then on, a single

Fig. 2.5. Arming scene of warrior with double row of *pteruges* depicted on Athenian red-figure cup by Douris. (R-3. Photo: Erich Lessing / Art Resource, NY. ART13897.)

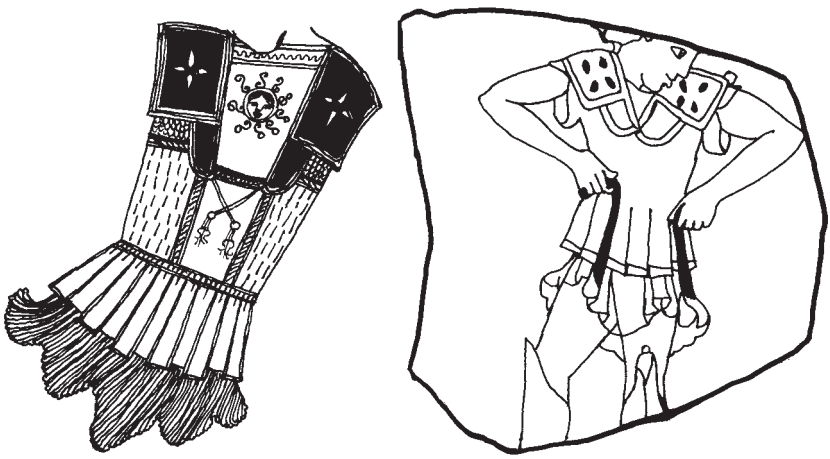

Fig. 2.6. Type IV corselet with crenellated *pteruges*, a decorative Gorgon head, and four-point stars (*left*). On a red-figure fragment, a warrior ties a belt around his armor (*right*). (*Left*, R-175; *right*, R-28)

row of *pteruges* dominates in art (see, e.g., figs. 2.1, right; 2.8; and 2.9, left).[15] This shift could have been due to stylistic preferences, but the change from a double to a single row (which uses less material) could have been brought on by a need to cut costs or decrease weight, or it may simply have been discovered that a second row of *pteruges* was not needed to provide the necessary protection.

There is an interesting correlation between the shift in the shape of the shoulder flaps and the switch from two rows to one row of *pteruges*. Over time, there was a pronounced tendency in the artistic images to pair the curved shoulder flaps with a single row of *pteruges*. This might seem obvious owing to the growing popularity of each from 475 B.C. onward; both styles appeared early on but were consistently paired with one another only after the almost total disappearance of the squared shoulder flaps and double row of *pteruges*. However, soldiers wearing Type IV armor with both the single and double rows of *pteruges* do appear together on the same vase, demonstrating that the choice of number of layers was not due to the painter's artistic license, laziness, or lack of knowledge about armor.[16] One final variation concerns the length of single-row *pteruges* on the same piece of armor. In just a few cases, the *pteruges* on an individual soldier with a single row will alternate in length from one to the next, creating a pattern that strikingly resembles the crenellations on a defensive wall (figs. 2.4, right; 2.6, left).[17]

Structural Elements IV: Scales, Bands, and Belts

One significant structural addition that a warrior could make to his armor was overlapping scales of some kind, presumably of metal, leather, or perhaps even laminated linen (any leftover scraps from the construction of the main pieces could be used for this purpose). Such scales are shown as being either rounded[18] or square[19] at the bottom (fig. 2.7). Examples of small bronze and iron scales have been found in excavations at Delphi, Olympia, and elsewhere.[20] These were presumably once attached to a corselet made of fabric or leather that rotted away, leaving only the metal fittings. Such scales often have small holes or loops by which they could have been either strung together or sewn individually onto a cloth or linen surface. Scales were usually arranged either in horizontal rows in which they were attached side by side or, in addition to being tied to their left and right neighbors, were connected to the scales above and below. The means of attachment consisted of thread or wire passed through the holes in the scales.

Scales also required some form of backing to which they were fixed by thread or wire. In the case of a laminated linothorax, bands of fabric on the outermost layer could have been left unsaturated with glue in order to facilitate the attachment

Fig. 2.7. Ajax wears a Type IV corselet with overlapping square scales (*left*), and a warrior is equipped with a corselet featuring rounded scales over the chest, the "wheel" attachment device, and decorative shoulder stars (*right*). (*Left*, R-77; *right*, R-193)

of the scales. They could also have been affixed with metal tacks or conceivably even have been glued on. Scales seem to have been added to almost any part of the armor, and in vase paintings occasionally they even cover the entire corselet, including the *pteruges* (fig. 2.8). At times, they were placed over just a single section of the body, such as the upper or lower torso; but in other instances, they spanned large swaths of the armor.[21] The most common areas on which they were placed were the chest, the abdomen, and the shoulder flaps.[22]

Though scales, regardless of their composition, would undoubtedly have increased the armor's level of protectiveness, the most surprising result of our systematic analysis of the visual database turned out to be how comparatively rare they are. Clearly identifiable scales appear on less than one-fifth of all Greek examples of Type IV armor.[23] Modern authors have often given the impression that such scales were a common feature of Type IV armor,[24] but statistical analysis of the visual images indicates otherwise. Overall, out of 913 total images of Type IV armor, 201 (22%) had some sort of clearly identifiable scales. Discounting Etruscan images, there were 122 out of 675 (18%) with scales. Some artists may have omitted scales to simplify their drawings, but the body of evidence strongly suggests that,

Fig. 2.8. Achilles bandaging Patroklos, on a red-figure cup by the Sosias Painter. Scales cover every surface of their armor, including the *pteruges*. (R-43)

while scales were by no means an unusual feature, a solid majority of Type IV corselets in the Greek world did not possess them.

While scales might be slightly more common on fifth-century B.C. depictions than on those from the sixth century B.C., the difference is not significant enough to state that scales became more popular over time.[25] More likely, scales were always a possible option, and whether a cuirass was given this extra element was a function of personal choice and the financial status of the wearer. While enhancing the protective ability of the armor with scales might at first glance appear to be attractive, adding scales, especially metal ones, had its drawbacks. First, a corselet equipped with scales would have been far more delicate than a plain linen or leather one and would have required much more careful handling and storage. Reenactors wearing scale corselets have found that rows of scales frequently come undone when the threads or wires holding them break, and thus they demand considerable maintenance and repair.[26] Corselets featuring scales would also have been prone to rusting, and thus would have entailed much additional time spent polishing and scrubbing the metal.[27] Scales would have greatly increased the total weight of a corselet, potentially doubling or even tripling it, with a concomitant reduction in the mobility and endurance of the wearer. Finally, scales would have added substantially to the cost of a corselet, necessitating expensive materials and the services of a specialist in metalworking.[28]

In terms of the advantages that scales offered, a very hard but thin layer of scales, backed up by a thicker, flexible layer of cloth or leather, could have provided an effective combination to resist blows. Because, as will be discussed later, there seems to be a practical limit to laminated cloth armor of about 12- to 15-mm thickness, the addition of scales could also have been a way to augment the protective ability of a predominantly cloth corselet. Scales would have been most worth the extra effort and expense in offering additional protection to especially vulnerable portions of the torso, such as the abdomen. In the end, however, the most attractive feature of scales was probably that they enhanced the wearer's appearance. Shiny armor was simply more impressive looking. As Croom (2000, 132) comments, "It is well known that in the ancient world well-kept, gleaming armor was thought to reflect the discipline and morale of the army and therefore demoralize the enemy." In the Greek world especially, such additions to one's armor would have served as a highly visible and public statement of the wearer's wealth and an indication of his social status. The presence of scales, therefore, is perhaps best viewed as a status symbol.

Some images of corselets depict a band running horizontally, most commonly around the midsection of the warrior, and covered in a crosshatched pattern.[29] It is

unclear whether this represents some sort of plaited sash or belt, a poorly rendered band of scales, or simply a painted design on the surface of the armor. When located around the midsection, it always appears at or just above the seam where the corselet and *pteruges* meet. There are no obvious clues that might identify what this band was made from, or even if it differed from the overall material of the armor. The crosshatching evident on some versions of this band is reminiscent of the stitching sometimes used on quilted materials, and it is possible that this drawn feature represents a band of quilted (and perhaps stuffed) fabric wrapped around the midsection to give supplemental protection to this vital area. It is also possible that the crosshatching depicts some sort of weaving done with thicker bands of material, perhaps plaited fabric cords or leather strips, to form a wide belt around the midsection in order to enhance protection. Such a technique, employing especially thick cords, brings to mind the way in which some scholars have speculated that the famous corselets donated by king Amasis of Egypt were made.[30] This particular form of crosshatching rarely occurs on other areas of the armor, suggesting that this object served some structural purpose rather than merely being a fashionable accent. This feature is most common on black-figure vases, so it seems to have fallen out of popularity in the early fifth century B.C.

One possible identification of this band is that it may represent the mysterious piece of equipment known as a *zoster* (ζωστήρ), first mentioned in the *Iliad*.[31] The *zoster* was plainly some sort of belt or wrap worn by warriors around their midsection, but its exact form and composition have remained obscure. If it is not just a painted decoration, this band appears to be a woven feature made of fabric, and one possible reason why the term *zoster* has not been associated with it is because, in their lexicon, Liddell and Scott state that the *zoster* was "probably of leather covered with metal plates," and subsequent scholars have often accepted their assumption about its composition as fact (e.g., Anderson, 1970, 26). There is, however, absolutely no ancient textual evidence that the *zoster* was made of leather or that it was covered in metal plates.[32] A clue as to its construction can perhaps be found in the linguistic root of the word, which is shared with the related and more common term *zona* (ζώνη), a woven girdle or belt worn by women and often associated with fertility.[33] Because the *zona* was explicitly a beltlike garment woven from textiles, it seems likely that the male variant would have been manufactured in a similar way.

True belts appear to have been relatively rare but were clearly discernible on a few examples, most notably the Alexander Mosaic (plate 2 and fig. 2.6, right). When present, these sorts of belts were wrapped around the waist and knotted together near the navel. While such belts are found infrequently on warriors wear-

ing Type IV armor, they are common in later depictions of Romans in muscle-type cuirasses.

Decorative Elements I: Painted Designs

In terms of purely decorative elements, Type IV armor ranges from the very plain, with no added ornamentation, to the extravagantly embellished. Every surface could be adorned with designs; the armor was a blank canvas on which the warrior (or the craftsperson who made it) could paint in order to produce a personalized and unique creation. The visual images do not suggest any attempted standardization in terms of decoration, and almost no two sets of Type IV armor are identical. This could have been done deliberately in order to distinguish among individuals, so that warriors could have easily been recognized on the battlefield by their armor's design. Decorations also undoubtedly served as a type of status display, in which affluent or high-ranking individuals used elaborate or expensive decorations as a way to boast of their status. Despite the considerable degree of individuality observed on Type IV armor, nonetheless there do seem to have been some patterns and designs that were more frequently applied than others.

The single most common decorative element featured on Type IV armor was a multipoint star or sunburst. Some variant of this basic pattern appears on more than 20% of the corselets. The specific details of how the star (or sun) is portrayed vary enormously. Some are a simple line drawing of a star or sunburst, while others are rendered more three-dimensionally in a broad petal shape, with faceted individual rays. The number of rays on a single star ranges from 4 to 16; within the same figure, they can vary in length or be uniform in appearance.[34] Although found almost entirely on pre-Hellenistic Greek armor, they are strongly reminiscent of the familiar starburst symbol encountered on Macedonian artifacts. In terms of their chronological distribution, these stars appear consistently and frequently on Type IV armor throughout all time periods and do not seem to have been either more common or rare in any particular era. As a decorative element, the star apparently had constant and enduring popularity and appeared far more often than any other design, including the meander (or Greek key) design. More than 100 instances of stars on separate Type IV corselets were found.

When gathering data on the number of stars observed in the visual database, we adopted a minimalist methodology. We counted only stars that were clearly visible and identifiable, and the same was true for the number of points on each star and the number of stars per soldier. For example, if only one shoulder flap bearing a star was visible, the soldier was not recorded as having two stars on his

armor, because an assumption such as this would have skewed the overall numbers and because we did encounter instances in which both shoulders were visible but a given decoration was present on only one side (e.g., fig. 2.10, left).

The placement of the stars varied, but their usual site was on the shoulder flaps. Stars in this location accounted for about three-quarters of all examples.[35] The remaining stars were divided almost evenly between the torso and the back (fig. 2.9).[36] In a few rare instances, stars were placed on the *pteruges*.[37]

Another variable was the number of points per star. In almost all cases, stars possessed 4, 6, 8, 9, or 16 points. In a few examples, a star was shown with more than 16 points, and when this occurred, the points were usually blended together in such a way as to make them virtually indistinguishable from one another.[38] Of the standard designs, an 8-point star was the most common, accounting for half of the examples (figs. 2.2, right; 2.3, left; 2.7, right; 2.9, left; 2.9, right).[39] The 4-point star was next, making up around 25% of the total (figs. 2.6, left; 2.6, right), while the 16-point star was the third most common at 15% (figs. 2.1, right; 2.9, right; 2.10, left).[40] The 6- and 9-point stars were rarities.[41]

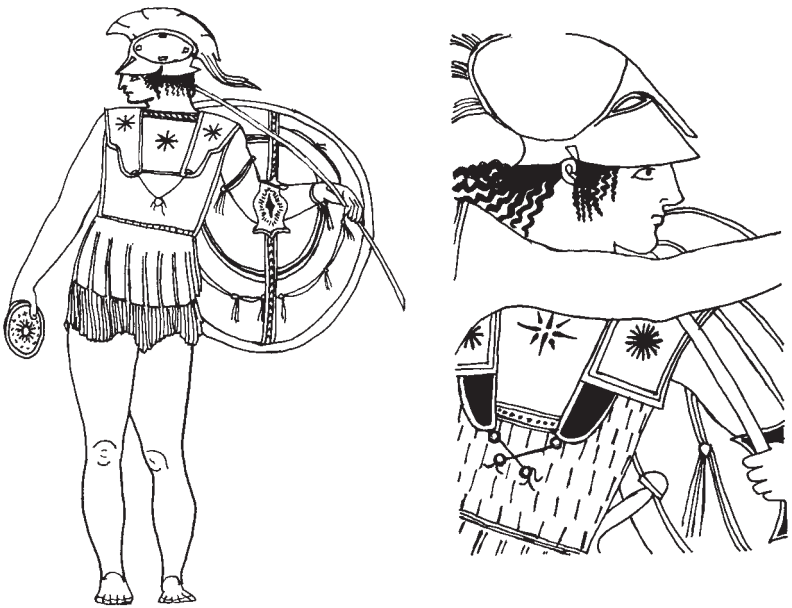

Fig. 2.9. Corselet with eight-point stars on both shoulders and chest (*left*); corselet with eight-point star on chest and sixteen-point stars on shoulder flaps (*right*). (*Left*, R-219; *right*, R-175)

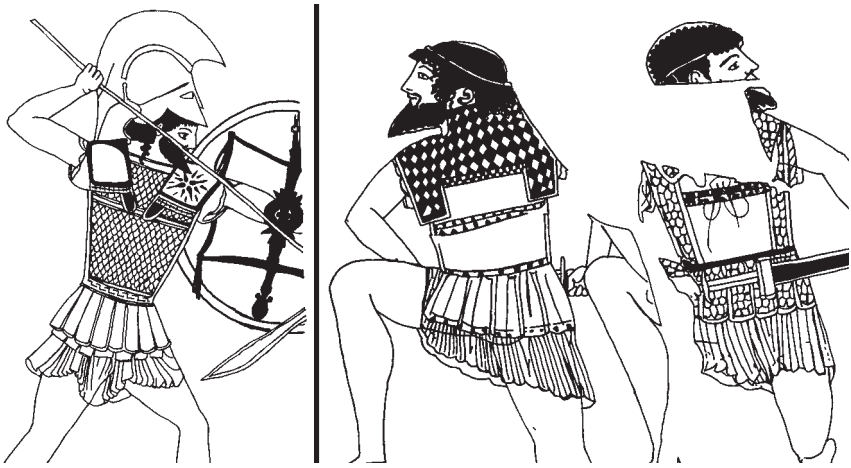

Fig. 2.10. Diomedes is shown with a corselet covered in scales with a sixteen-point star on only one shoulder flap (*left*); Odysseus and Diomedes are depicted in elaborate armor with scales and decorative patterns, including a striking checkerboard design on the back of one shoulder piece (*right*). (*Left*, R-113; *right*, R-106)

As one might expect, given that the most common location for stars was the shoulder flaps, the typical total number of stars per armor was two. Over 70% of star-bearing linothorakes had just two stars, usually one on each shoulder.[42] Interestingly, when a star was painted in the center of the chest, it was almost always accompanied by two additional stars on the shoulder flaps (fig. 2.9, left and right).[43] Soldiers with more than three stars on their armor were rare, although there are a few examples.[44] There were instances in which a soldier was depicted with a star on just one of his shoulder flaps, while the other was blank (counted only in cases in which both flaps were plainly visible) (fig. 2.10, left).[45] An early hypothesis that lone stars always occurred on the soldier's right shoulder flap, thus remaining uncovered when the soldier wielded a large shield that would obscure his left side, was disproved after we found some examples of a single star appearing only on a soldier's left shoulder (fig. 2.10, left). Therefore, there is no obvious reason to have a star on either shoulder flap. The decision to put a star on a particular shoulder may have been left up to a soldier's personal preference or the artist's choice. An intriguing possibility is that it could perhaps have functioned as a mark of distinction or of military rank, as such emblems often do in later armies, although there is no ancient textual evidence to support such an interpretation.

In addition to stars, a wide range of painted objects and geometric patterns can be observed on the armor, including circular dots arranged in a repeating

symmetrical pattern; dashes or lines; a zigzag (whether repeating vertically or in a single undulating line); a repeating square or checkerboard pattern; variants on the meander (Greek key) design; and sundry stripes on different parts of the armor, most often along the bottom edges of the *pteruges* or as bands around the chest (fig. 2.10, right).[46]

The marks that we have identified as decorative dashes or lines include only those that cover a limited and well-defined portion of the armor or are plainly part of a larger painted design and therefore are unlikely to represent lines of stitching. This was an important distinction to make because we did not want to confuse potential evidence for quilted or sewn armor with superficial painted decorations. Markings that we have interpreted as possible signs of quilting were those that appeared either in a consistently repetitive pattern over broad areas of the armor or in places where seams might logically be found. Of course, there is no way of absolutely knowing whether some of the dashes or lines that we counted as painted decoration might in reality have been intended to represent some sort of stitching, but we tried to err on the side of caution by considering anything that might be evidence of a sewn seam as such. This decision means that inevitably we did not count some lines and dashes that are actually decorative elements, so the total incidence of painted lines and dashes is probably somewhat higher than what we have indicated.

Examination of the visual database led to a few conclusions that were contrary to our initial expectations. The famous meander pattern, which is probably better known by its modern name, the Greek key design, turned out to be a relatively uncommon decoration, and even fewer Type IV corselets were adorned with animal, human, or mythological figures (such as Gorgon heads or deities) or with objects symbolizing states, gods, and virtues. Given the Greeks' propensity for adorning their shields and coinage with such images, this came as somewhat of a surprise. Although some vase paintings show ambiguous blobs on the armor that might well be such images, the Type IV corselets with identifiable figures of some kind total only around three dozen. Of these, the most frequently occurring was a Gorgon or Medusa head (plate 2; fig. 2.6, left).[47] The generally apotropaic nature of this figure, and the useful metaphor, in a military context, of turning an opponent to stone (or freezing him with fear) easily explain its popularity.[48] These heads were inevitably located in the center of the chest between the two arms of the shoulder flaps. Given this positioning, they had to be relatively small in size, no more than 10–15 cm in diameter. Because of this size restriction, they would have been recognizable from only a fairly close range and were thus unlikely to have played a significant role in identifying the combatant from a distance.

About half of such figures represented animals, with lion or panther heads and snakes the most popular choices (fig. 2.11, left and right).[49] A typical arrangement was to have a pair of animal heads, with one on each shoulder flap. The famous Aristion stele seems to sport such a pair of lions' heads.

In addition to the center of the chest and the shoulder flaps, the only other location on which animal heads were observed was the wide rectangular section of the shoulder piece that covered the wearer's entire upper back (fig. 2.11, left). Although most ornamentation seems to have been frontally oriented, this space was a relatively large one and would have been the most visible part of the armor when observed from behind, so it seems a natural spot for a sizable, colorful image. On rare occasions, some other figure could be made out, such as the outline of a running man on the shoulder flap of one warrior.[50] With the entire surface of Type IV armor available for adornment, it is interesting to note the relative dearth of figures, big or small, especially when considering the many richly decorated and creative shield designs portrayed on vase paintings. What seems to have been preferred on body armor were geometric patterns and recurring shapes, such as squares and checkerboard motifs, dots and dashes, zigzags, and occasional variants on the Greek key design. Despite the Greeks' admiration for the athletic male form, there is no

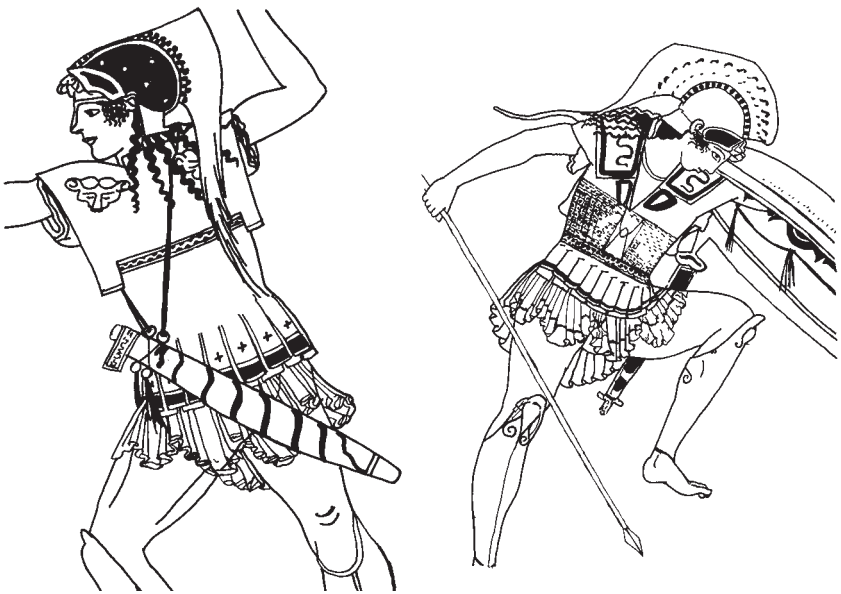

Fig. 2.11. Warriors with decorative animals painted on their shoulder flaps: panther heads (*left*) and snakes (*right*). (*Left*, R-89; *right*, R-85)

evidence on Type IV armor of a painted equivalent to the realistically molded muscles found on the muscle-cuirass. In fact, what was most commonly observed on the stomach area of Type IV armor was a simple plain, smooth surface, free of any design.

Decorative Elements II: Color

While an examination of vase paintings can reveal a great deal about structural variants of Type IV armor and the decorations and patterns that appear on it, we remain largely ignorant of the coloration of the armor and its decorations. The majority of representations are done in red- and black-figure, which usually give us only a two-tone image of the armor. Not infrequently on black-figure vases, the armor is painted white, which is certainly suggestive and has sometimes been taken as evidence that the painting is meant to portray cloth armor.[51] However, while in some cases this choice of coloration was probably intended to indicate that the armor was made of fabric, there are many other instances that could be cited of objects that are clearly metal, such as helmets, greaves, and muscle-type cuirasses, also being colored white by the artists. Thus, white coloration alone cannot be taken as a reliable indicator of material.[52] The majority of images of Type IV armor are on red-figure vases, where they are drawn outlined in black and colored the baked clay's natural red hue. Fortunately, our knowledge of what Type IV armor may have looked like in reality can be supplemented by several spectacular tomb paintings as well as traces of paint remaining on some sculptures that depict warriors wearing these corselets. From these, we are able to get at least a partial glimpse at how some examples of Type IV armor may have originally appeared in full color.

The clichéd image of Type IV armor is that it was predominantly white, an assumption that rests on the idea of white as being the "natural" color of linen in the modern world.[53] Linen fabric in its natural state is not white but shades of tan, khaki, or light brown. Linen can, however, be bleached to a light gray or even a true white by a number of methods, many of which were known in the ancient world. Therefore, ancient linen armor could have been white, an impression that the frequent choice of white paint for this armor on vase paintings at least superficially appears to reinforce. Although white or whitish armor might produce a striking visual appearance, it does not seem to be a practical color for an object that was used in active field conditions where it would have been exposed to mud, dust, blood, and any number of other substances that would have discolored or stained

it. Against this, it should be noted that another of the attractive qualities of linen is that, among fabrics, it sheds dirt and dust unusually readily and washes clean quickly and easily.[54]

Nevertheless, for extended use in the field, it would seem to make sense to dye the fabric some equally visually striking but potentially less easily soiled color. Complicating matters again, however, is the nature of linen itself. Linen fibers are especially hard and thus do not absorb dye as well as the fibers of other textiles, such as wool and cotton. For the same reason, when linen is dyed, the colors have a tendency to wash or rub off easily. Even with modern technology, "linen is notoriously difficult to dye well."[55] This characteristic of linen provides a compelling reason why Type IV corselets may have indeed been primarily white in color. Bleaching the linen was simply a relatively easy way to impart a handsome appearance to the armor. We might then interpret linen corselets that were dyed extensively as statements about the status or wealth of the wearer, since applying permanent colors to linen required considerable effort and expertise. Finally, we should keep in mind that not all of the linen that went into a corselet would have to have been bleached or dyed, just that used for the outermost layer. Probably most linen corselets were constructed of natural, unbleached linen, and then bleached or dyed fabric was used only for the final, visible, outermost layer.

One late sixth-century B.C. artwork that offers a hint of what a highly decorated Type IV Greek corselet might have looked like in color is the grave stele of Aristion (fig. 2.12). This over-life-size marble relief retains traces of paint that reveal an elaborate and colorful decorative scheme. The entire outer surface of the armor may have been painted (or dyed) a yellowish color, with many of the edges trimmed in blue.[56] On the right shoulder (the only one visible) is a large 16-point star with a red center whose blue and green rays alternate in length. The shoulder flaps are of the squared-off variety, and the lower portions of these are painted a vivid red. Upon this red field is a large, detailed lion's head sporting a curly mane. Across the chest is a thick, horizontal band with a double crenellated design in green and blue. Below this, in the region of the floating ribs, is a strange oval device with four projections whose details are difficult to make out, but it seems likely to be the attachment point for the cords that hold down the shoulder flaps. It is positioned well to the right of the warrior's centerline, so we can infer that a companion attachment point must be located on the nonvisible left side, making this corselet an example of the parallel attachment point system. Around the waist is another thick horizontal band or belt of about the same width as the one encircling the chest. This one is decorated with a vertical zigzag pattern of alternating green and blue lines. Finally,

Fig. 2.12. The Aristion Stele. Although greatly faded, it is possible upon close examination to make out an elaborate scheme of painted decoration on the armor, including stars, animal heads, and a Greek-key pattern. (S-4. Photo: Scala / Art Resource, NY. ART64296.)

even the *pteruges* (arranged in two overlapping rows) are ornate. Each *pteruge* has its edges highlighted with blue paint and also features a horizontal decorative band halfway down its length. This band contains a blue and green Greek key design.[57]

This relief is one of our best guides as to what the coloration and decorative details of a Type IV Greek corselet would have looked like around 520 B.C. The fact that it is life-size (or larger) allowed the artist to include details that on a vase painting would have been greatly simplified or omitted altogether for reasons of scale. Because of this simplification process, which was frequently necessary when working on the surface of a small vase, it is likely that Type IV armor was in reality

more ornate in terms of decoration than is suggested by its depiction in vase paintings. Even the most basic corselet probably had at least a few colored patches or geometric designs similar to those found on the Aristion stele.

When reconstructing the colors of Hellenistic versions of Type IV corselets, of particular help are Macedonian tombs decorated with frescoes of warriors wearing the armor. The amount of color shown as having been used, on both the armor and the clothing underneath, is remarkable. There are three prime examples that stand out: the tomb at Agios Athanasios, the Great Tomb at Lefkadia, and one of the tombs under the Bella Tumulus.[58] A panel in the Agios Athanasios Tomb III portrays two warriors in Type IV armor that is completely purple with a darker purple trim, which is especially prominent on both rows of the *pteruges*. They wear different-colored tunics underneath, blue and white respectively, and yellow *chlamys*. The facade of the Great Tomb at Lefkadia depicts a warrior wearing Type IV armor with the shoulder piece colored a reddish-purple hue, while the rest of the armor is white. A square-shaped section of the armor on the chest is the same reddish purple as the shoulder piece, as is a thick band that encircles the midsection just above the seam where the *pteruges* begin. Finally, there is a reddish stripe along the bottom edges of both rows of the *pteruges*, creating a staggered line effect. As for the clothing under the armor, the warrior's tunic is also dyed a reddish purple, and the color of the *chlamys* resembles that of the warriors in the Agios Athanasios tomb painting. The soldier depicted in the Bella Tumulus tomb wears multicolored Type IV armor similar to that of the warrior on the Great Tomb; his shoulder piece is light purple with red trim, while the rest of the armor is white. There is a brownish Gorgon's head on his chest. Like the warrior on the Great Tomb, he has red stripes along the bottom edges of both rows of his *pteruges*. His tunic is light blue, and he holds a red *chlamys* that is wrapped around his body.

Another possible piece of evidence for colored Macedonian versions of Type IV armor is the Alexander Sarcophagus, on which a large number of warriors are portrayed wearing the armor. Although the colors have faded, enough traces remain to be able to discern a vivid, even garish, original color scheme for at least seven of the figures in Type IV armor. One warrior on long side A (where a mounted Alexander is spearing a Persian) has a corselet with reddish-looking coloration adorned with yellow details and yellow *pteruges*.[59] On pediment A, a wounded soldier wears a purplish Type IV corselet with a belt of an even darker hue, while a standing warrior sports purple armor decorated with a Medusa's head on the chest. His *pteruges* are yellow, with darker yellow or golden tassels on their ends. Another standing warrior holding a captive is similarly attired in a purple cuirass with yellow *pteruges*

(plate 3). A total of three warriors on pediment B are identifiable as wearing Type IV armor. Two of them, who are Greek or Macedonian, have corselets that are shades of yellow and purple, respectively, with bluish *pteruges*. A third, who is Persian, wears a yellowish Type IV corselet decorated with a broad horizontal purple band, in the center of which is located what appears to be a Medusa's head. The range of hues on this monument echoes the color palette in the tombs found in Macedonia, particularly in their fondness for shades of red and purple.

Also similar in coloration to the armor depicted in the Macedonian tombs is the Type IV cuirass worn by Alexander the Great in the Alexander Mosaic from Pompeii (plate 2).[60] A first-century B.C. Roman copy of a fourth-century B.C. Hellenistic artwork, it is an extremely detailed full-color portrait offering a rare image of Alexander in armor. Like the painted warriors of the Bella Tumulus and the Great Tomb, Alexander has reddish-brown (perhaps even purple) shoulder pieces with red trim and edged with decorative bands of small purple squares. In the center of Alexander's chest is a panel of the same purplish color emblazoned with an intricately rendered Gorgon's head. The body of his armor is off-white, with multiple horizontal bands of reddish brown or purple. His corselet is accented with a green or gold belt tied at the navel. His double rows of *pteruges* are the same off-white color as his armor and are edged with black stripes and fringed. Unusually, Alexander's armor also possesses a single row of *pteruge*-like flaps around the tops and sides of the shoulder openings. These are identical in appearance to those around the bottom edge of his armor.

A final body of evidence for how some Type IV corselets were colored comes from the western Mediterranean, where Etruscan paintings depicting Type IV armor have survived. Like the Macedonians, they seem to have favored a vivid color palette. The François Tomb, the Tomb of Orcus, and the Amazon Sarcophagus in Florence show warriors wearing Type IV armor and all are similar in coloration.[61] Eight warriors in these three examples wear Type IV corselets that are predominantly white, with reddish trim on the shoulder pieces. The warriors in the François Tomb also have red trim on their torsos. A warrior on the left has a pattern resembling a vine or ivy running around his abdomen, red trim on the bottom edges of his *pteruges*, and red decorations on the *pteruges* themselves. A warrior on the right has a red-and-black crenellated design near the top of the torso section of the armor and a red crenellated design around his waist; he also has four-point red stars on his *pteruges*. The warrior in the Tomb of Orcus has a red-and-black Greek key design running in a horizontal band around his chest and a second one around his waist. He has red edging and a black comblike design on his *pteruges*. The warrior on the end panel of the Amazon Sarcophagus in the Florence Archaeological

Museum has a plain all-white Type IV corselet with simple red trim (plate 4). In the panel on the long side, one warrior is again shown in all-white Type IV armor with the typical red trim. As additional ornamentation, he has red palmettes on his chest and four-point red stars repeating around his abdomen. A second figure wears a similar red-trimmed white corselet with a Greek key pattern on a band around his waist and a large palmette-type design in the center of his chest.

Taken together, all the color examples of Type IV armor create a fairly consistent picture of how this armor was decorated and what colors were used. In most cases, the linen of the armor was left in its bleached form, giving it a white or off-white color. Some small sections of the armor, most typically a chest panel or the end sections of the shoulder flaps, were painted or dyed red or purple. The apparent general reluctance to dye larger swaths of the armor is probably best explained by linen's resistance to dyeing. One of the simplest and most common embellishments was to paint various edges, such as on the shoulder flaps or around the *pteruges*, again most frequently in red.[62] This would have required little artistic skill, but still lent a bold, attractive look to the armor. Adding lines of dashes, dots, or checkerboard patterns was another simple way to enhance the appearance of a corselet. The next step up in elaborateness was to apply decorative bands, usually adorned with more complex, repeating geometric patterns, around the waist and chest, or on the *pteruges* or shoulder flaps. As for painted images, the simplest (and again, not surprisingly, the most common) were multipoint stars. As with the edging, this was so basic a design that it would have been within anyone's ability to paint a couple of them on his armor. More artistically demanding (and much rarer) painted images were typically the heads of fierce creatures, real or mythological, such as Gorgons and lions. The simplicity of the most popular decorative schemes suggests that individuals (or their households) were making and adorning their own armor.

Distinctive Aspects of Etruscan Type IV Armor

Although we have included Etruscan examples of Type IV armor in the visual database, they represent a somewhat distinct line of development from the Greek and Hellenistic versions of the armor, and while there are many similarities in terms of their structural and decorative characteristics, there are also a few notable differences.

In addition to the tomb frescoes mentioned above, Etruscan images of Type IV armor are most commonly found on bronze and terracotta objects. While some of these images are simply line drawings incised upon bronze cists and mirrors, there are terracotta sculptures and bronze statuettes that reveal the armor in all three

dimensions, a rare perspective among the Greek and Hellenistic examples. In overall form, the Etruscan samples of the armor are nearly identical to the Type IV armor seen on Greek vases and monuments, Macedonian frescoes, and later Hellenistic and Roman monuments. The Etruscan versions also share the same set of standard structural variations: shoulder flaps occur in the same squared or rounded shapes, there are identical shoulder flap attachment methods (central, parallel, and crossed), and they possess either a single or a double row of *pteruges*.

The main structural difference has to do with the use of scales. Whereas scales were present on only 18% (122 of 675) of images of Greek and Hellenistic Type IV corselets, they appear on nearly 34% (79 of 235) of Etruscan ones. There does not seem to be any chronological pattern to the Etruscan employment of scales, and examples both with and without scales occur throughout the entire period of attested visual evidence. The Etruscan scales are almost always square or rectangular. A rare instance of a figure clad in overlapping scales with rounded bottom

Fig. 2.13. Etruscan bronze statuette from Falterona of warrior with large, overlapping, square scales on torso. (M-25)

Fig. 2.14. Etruscan bronze cist handle in the form of two warriors carrying a fallen comrade. Note the Xs on the shoulder flaps of the central figure. (M-29. Photo: Scala / Art Resource, NY. ART52344.)

edges can be seen on a bronze statuette of a warrior from Lake Falterona.[63] The scales usually appear to be quite large, with the images giving the impression that their sides are at least 5 cm long (fig. 2.13). Although many of these are overlapping, in some images, particularly those featuring the largest scales, they do not seem to overlap, suggesting that they may be plates sewn on or otherwise affixed to the underlying corselet edge to edge in rows.[64] An exception to the use of large scales is the famous nearly life-size statue of the Mars Todi, whose carefully sculpted rectangular scales are small, no more than 1 cm wide and 3 cm long.[65]

The wide band of scales around the lower torso, so familiar in Greek depictions of Type IV armor, is almost nonexistent in Etruscan art.[66] Most often, the scales

Fig. 2.15. Lid of Etruscan incised bronze cist with ten warriors, all wearing Type IV armor. Note the extensive use of scales and the distinctive Etruscan Xs on their shoulder flaps. (M-61)

cover the entire surface, both front and back, of the corselet, frequently including the shoulder flaps as well as the main body section. All of these scales would have made the typical Etruscan Type IV corselet considerably heavier and hotter than its standard Greek counterpart and, depending on the thickness of scale and corselet, potentially more effective protection. For military historians, the generally heavier nature of Etruscan armor might have interesting implications when considering the Etruscans' style of warfare, as well as related issues such as the mobility of an Etruscan army.

As for decorative elements on Etruscan Type IV armor, while the basic color palette is similar to that of eastern Mediterranean styles, differences do emerge in some of their preferences for painted designs and patterns. Multipoint stars, which were the most common decorative pattern on Greek armor (appearing on at least one-fifth of the Greek examples) and which were found on almost every part of the armor, are nearly absent on Etruscan corselets.[67] On the other hand, in bronzes, terracottas, and tomb paintings, Etruscan warriors are often depicted with ornate

horizontal bands at the level of the chest or waist. These bands feature a variety of patterns, including Greek key, horizontal chevrons, dots, squares, zigzags, checkerboards, and a kind of curling wave motif.[68]

One pattern that seems uniquely Etruscan is a large X prominently placed on the terminal sections of the shoulder flaps (figs. 2.14, 2.15).[69] One might assume that these are four-point stars that have been simplified by the artist for ease of depiction. We do not believe that this is the case, however, because the arms of the X are always shown touching the border of the square box within which they are incised or painted. This is quite different from the manner in which stars are always shown on armor, such that the rays of the star are never shown extending all the way to the surrounding borders. Also, the Etruscan X is always drawn with thin lines of even thickness, whereas the rays on Greek star motifs either taper from being thicker at the center to a narrow point at the end or bulge noticeably in the middle. Therefore, the X on the shoulder flaps seems to be a distinctively Etruscan design motif.

The range of elaborateness of Type IV armor, in terms of both decoration and structure, was considerable. No two sets of armor were identical, and even extremely plain ones often differed slightly from one another. Such uniqueness suggests that this type of armor was individually designed, either by the person who made it or by the person who commissioned its construction. Warriors who needed mobility or who were more impoverished could opt for a plainer style without scales; warriors of greater means or desiring extra protection might have scales added. Different decorative elements could be mixed and matched on the basis of personal preferences, cost, or functionality. The possibilities were practically endless.

Despite these many variations, there were a few marked trends. There seems to have been a general switch from squared-edged flaps to curved ones around the beginning of the fifth century B.C. Overall, the *pteruges* on Type IV armor appear in a single row more often than in a double row but, like the shoulder flaps, the transition from the double row to the single row occurs around the beginning of the fifth century B.C. The single attachment point, usually positioned at the center of the chest, was the most common means of securing the shoulder flap ties, followed in popularity by the double parallel attachment system. Several other methods were used, with no clear favorite evident at any given period. Scales, either rounded or square, are found on about 18% of the Greek examples but on 34% of the Etruscan ones. They are observed in every degree of coverage, from small panels to the entire corselet, from shoulder flaps to *pteruges*.

There were also trends in terms of the choice of decorative elements. Belts or bands, while not extremely common, showed up regularly. Stars (or sunbursts) were the most frequent decorative element on Greek armor and occurred in a variety of permutations. Other simple decorative markings, such as dots, dashes, zigzags, Greek key, and checkerboard patterns, were popular and appeared in every combination. Colored edging around the shoulder flaps, *pteruges*, and other areas was a feature of many corselets, even those that lacked any other type of adornment. Detailed images, such as an animal or Gorgon's head, were quite rare. The dominant color of Type IV corselets seems to have been determined by the innate qualities of linen. This fabric does not take dye readily but can be bleached relatively easily to an attractive shade of white, which seems to have become the default color for this type of armor. Both vase paintings and tomb paintings stress white as the standard color of Type IV armor, which could be interpreted as further evidence that it was predominantly made of linen. When all or part of the armor was painted or dyed, however, ancient warriors favored vivid (and easily found and applied) colors such as red and purple. The lack of overly complicated and hard-to-draw images and a corresponding preference for simple patterns reinforce the idea that, in general, constructing a linothorax was a do-it-yourself proposition. Nevertheless, with so many structural and decorative elements available, Type IV corselets offered fertile ground for imaginative customization and individualization, even for those with minimal artistic abilities.

What Material Was Used to Make Type IV Armor?

In the attempt to reconstruct an example of Type IV armor and figure out what it was made of, one of the greatest challenges stems from two apparently conflicting characteristics evident in the visual images. On the one hand, the basic material of Type IV armor possessed considerable flexibility, because vase paintings portray ancient warriors putting on this type of armor by dramatically bending the main section from a flat rectangle into a tube shape that encloses their torsos (figs. 1.1, left; 2.5; 3.1; 8.1). Similarly, the shoulder section is shown bending from a flat shape to a sharply curved one as it comes forward around the neck and is tied down on the upper chest. On the other hand, vase paintings also depict the shoulder flaps standing rigidly and vertically upright before they are tied down, and springing upright when they are untied (figs.1.1, left and right; 2.5; 3.1; 8.1; compare with fig. 3.2).[1] Thus, whatever substance the armor was made of had to be flexible enough to bend from a flat to a tubular shape, yet also sufficiently rigid to stand up on its own. This combination of flexibility and rigidity is difficult to replicate in practice and has led to a great deal of speculation and debate about possible materials and construction methods.

To account for the conflicting qualities of Type IV armor, five competing hypotheses have been proposed for its method of construction: leather; layers of linen sewn or quilted together; layers of linen glued together; a combination of these materials, with the most commonly proposed arrangement being a central core of leather with one or more layers of linen attached on the outside; and a core of metal plates with leather or linen affixed to the outside. We will consider the main evidence and arguments for and against each of these ideas.

Leather versus Linen Construction

One possibility is that Type IV armor was made of leather. This is the conclusion reached by Jarva who, while conceding that some examples of Type IV on vases probably do depict linen or metal versions, argues that the leather form was the dominant one and that the others were simply imitations of it. Before discussing

Fig. 3.1. A scene of a warrior arming from an Athenian red-figure cup. He is bending the main portion of his linothorax from a flat to a tubular shape to fit around his torso. Note the manner in which the untied shoulder flaps stick upright. (R-154. Photo: © The Trustees of the British Museum.)

the likelihood that Type IV armor was made of leather, it is first necessary to sort through a terminological debate concerning a word that is sometimes thought to refer to this type of armor. Jarva and others equate Type IV armor made of leather with the word *spolas*.[2] This is a rare word in ancient texts, and the identification of *spolas* as armor is based mainly on a single source, the second-century A.D. *Onomasticon* of Pollux. In a rather confused passage in this work, a *spolas* is described as "a *thorax* of skin which hangs down from the shoulders, as Xenophon said 'and *spolas* instead of *thorax*.' Sophocles considers it a Libyan custom: a Libyan *spolas*, a leopard skin" (σπολὰς δὲ, θώραξ ἐκ δέρματος, κατὰ τοὺς ὤμους ἐφαπτόμενος,

Fig. 3.2. Putting on a reconstruction linothorax. Compare the raised shoulder flap with those seen on Greek vase paintings, as in fig. 3.1.

ὡς Χενοφῶν ἔφη, καὶ σπολὰς ἀντὶ θώρακος. Σοφοκλῆς δ' αὐτὴν Λίβυσσαν νομίζει, σπολὰς Λίβυσσα, παρδαληφόρον δέρος., 7.70). This description does potentially match the way that Type IV armor was worn and the prominence of the *epomides*. It also states that the *spolas* is one type of *thorax*. Because the word *thorax* is used to mean substantial body armor, on the surface, this passage appears to provide evidence that the *spolas* was a type of armor.

Unfortunately, the reliability of this passage is highly questionable. A confusingly jumbled string of citations from other authors, these lines contain nothing that unequivocally links the *spolas* specifically to Type IV armor. The fact that it is described as hanging from the shoulders is unremarkable, because this statement could be made of nearly every type of body armor. The Sophoclean Libyan

anecdote within this passage concerns animal skins worn over one shoulder and not the distinctive Type IV armor.[3] Most problematic of all, however, is that Pollux's *Onomasticon* is a dubious source for information about Greek armor, even by the standards of ancient texts.[4] Pollux was a pedantic antiquarian of the second century A.D. best known for his musical skills, and the original *Onomasticon* was lost and survives only in the form of summaries compiled and interpolated by Arethas, the archbishop of Caesarea around A.D. 900. All of this renders the application of this passage to Type IV armor, and to the time when the vase paintings and its other visual depictions were created, questionable.

Examining the usage of the term *spolas* by more dependable authors does not help to clarify the issue, because other than the single tenth-century A.D. *Onomasticon* passage, there are no definite further mentions of *spolades* as armor.[5] In Xenophon's *Anabasis,* during an emergency, an impromptu group of cavalry is said to have been hastily equipped with "*spolades* and *thorakes*" (καὶ σπολάδες καὶ θώρακες αὐτοῖς ἐπορίσθησαν, 3.3.20). We interpret this line to mean that the men are equipped with both *spolades* and *thorakes*, which suggests that these are two different things rather than variants on the same item. There are two ways to read the passage: that each man got both items (in which case the *spolas* would seem to have been a leather shirt worn under armor) or that some men received *spolades* while others were given *thorakes* (in which case both were types of principal armor). If one accepts the latter reading, then it is possible that the *spolas* could have been Type IV armor, but this is not the usual way in which this passage is translated. Later in the same work, a soldier is killed by an arrow that pierces through both his shield and his *spolas* (τοξευθεὶς διὰ τῆς ἀσπίδος καὶ τῆς σπολάδος, 4.1.18). This second Xenophon citation is similarly ambiguous in that it is unclear whether the *spolas* was merely a leather shirt or a more solid form of armor.[6] Nothing in these passages explicitly identifies the *spolas* as a piece of armor rather than just an item of clothing. The same passage of the *Onomasticon* refers to a fourth use of the term *spolas*—a lost fragment of Sophocles that depicts Libyans wearing *spolades*—although here it clearly means skins from leopards (frag. 11).

Thus, we have one instance of *spolas* denoting an animal skin, two ambiguous uses, and a single very late and rather questionable source that says it is a type of armor. Fortunately there is one more author who makes use of this rare term and who offers a way to clear up this uncertainty. Even better, the author in question is both a Greek and an exact contemporary of the majority of the visual images of Type IV armor. In his play, *The Birds*, Aristophanes uses the word *spolas* twice in a context that leaves no doubt that, while it is some sort of outer garment, it is not a type of armor analogous to a *thorax*. In the play, there is a witty exchange center-

ing on an impoverished poet attempting to wheedle gifts from a citizen (*Birds* 930–44). In the end, the citizen commands an attendant (either a slave or a temple acolyte) to strip off his *spolas* and give it to the poet. Because it would be extraordinarily odd for either a slave or a priest's acolyte to be walking around the city in everyday circumstances wearing armor, *spolas* in this case clearly just means something akin to a crude leather overshirt or jerkin.[7] Furthermore, we can tell that the *spolas* in Aristophanes' play is an outer garment of some kind because the same character is subsequently also ordered to give to the needy poet the tunic (χιτῶν) that he is described as wearing beneath his *spolas*.

A *spolas*, therefore, would seem to be a soft leather jerkin or overshirt worn as a supplemental piece of clothing to give extra warmth, as a garment providing padding under armor, or as something to give protection against rain.[8] Certainly, impoverished soldiers might have worn such an item to offer them at least some degree of protection, but it is in no way equivalent to a substantial piece of armor, and it cannot be equated with the stiff and highly specialized construction of the Type IV armor evident in vase paintings. The *Onomasticon*'s identification of the *spolas* as a type of body armor, a *thorax*, is possibly an error, resulting from understandable confusion, due to the fact that many soldiers did indeed wear soft leather tunics called *spolades*, either as shirts under their armor or as a (very) poor man's substitute for its lack. If based just on the literary evidence, the identification of Type IV armor with the term *spolas* is rather tenuous.

A separate and more compelling piece of evidence in favor of Type IV armor being made of leather is the large body of comparative historical material from other cultures and eras demonstrating that leather has long been used either as armor or as a component of armor. Both of these statements are equally true of textile armor, however, and so do not offer definitive proof in favor of leather. Also, both leather and linen were widely available in the ancient world, making them likely materials to be used in many contexts, although their relative cost could be an issue (discussed in chapter 8). There is no doubt that leather was commonly employed as armor by many cultures, and it seems reasonable to assume that at times it served this same role in ancient Greece. But was Type IV armor composed primarily of leather?

Jarva (1995), who has made the most exhaustive examination of the evidence thus far, leans toward leather as the most likely material for this armor. He bases his argument mainly on certain visible features of Type IV armor (which he calls "typological rudiments"), which he claims make sense only if the substance being used is leather (44). Chief among these are the upright neck-guard section and the cutout flaps on the back near the armpits. He asserts that these are evidence that

the armor was cut from a single sheet of material, probably oxhide, and that only an animal skin would possess the combination of flexibility and stiffness described earlier (36–37, 44).

His arguments, however, rest on the assumption that armor made of leather would in all cases have been much stiffer than any that was fashioned out of linen. For example, he states that one way to distinguish leather from linen armor in art is whether the figure wearing the armor is in a pronouncedly bent posture; if so, it must be linen, because such a position "is not possible if a metallic cuirass or a corselet made of stiff hide is used, but we can assume that linen, even if stiffened, would have been more flexible" (44). While this assumption may sound reasonable, our reconstructions indicate that it is not true. As will be shown later, linen, particularly when laminated, can be quite stiff. For that matter, leather can be quite soft, and, in fact, after it has been tanned, is usually extremely flexible.

If Type IV armor was made out of animal skin, rawhide could not have been used. While it would theoretically be possible to mold rawhide into the shape of Type IV armor, once dried, such armor would not merely be stiff, it would be completely rigid—to such a degree that it could be neither put on nor taken off. Also, any subsequent exposure to moisture, including sweat, would reduce rawhide armor to an unpleasant and unwearable gummy state, and it would eventually putrefy. It is possible to treat rawhide so that it will be water-resistant, but again, in this state, it would be completely rigid and could not display the flexible qualities seen in the vase paintings. Thus, this argument for preferring leather over linen is based on a misleading assumption, and it leaves the question of what material was used still unresolved. If fashioned from animal skin, therefore, Type IV corselets had to have been made of tanned leather.[9]

One final method that has sometimes been suggested as a way to differentiate linen from leather in art is the color employed by the artist in depicting the armor. One of the initial reasons why linen was considered as a potential material for Type IV armor was the many images of whitish-looking armor worn by warriors in paintings, which naturally led to the conclusion that this substance could not have been leather or metal. It is certainly tempting to surmise that the color white in vase paintings indicates linen, whereas shades of red or brown were chosen to designate leather.[10]

As mentioned in the preceding chapter, one common but persistent misconception when considering the significance of color on vase paintings is the assumption that the default color of linen is white.[11] The natural color of linen cloth is shades of brown, ranging from a light sandy color to a dark tan (for an example of the color

of natural linen, see plate 8). Although linen can easily be bleached to achieve various paler shades, a common practice in the ancient world, a true white would have been rare.

Even more problematic, however, is the assumption that the colors on vases were meant consistently to depict certain materials rather than resulting from aesthetic choices. As Jarva (1995, 44) demonstrates with numerous examples, such variations in coloration often had more to do with changes in artistic conventions over time than with the materials being represented. Additionally, all these colors, including white, black, and brown, were used in cases where the armor is clearly metal, indicating that color is not a reliable guide to material.[12]

Finally, linen, leather, and metal could easily have been (and clearly sometimes were) painted or otherwise decorated, making nearly any color or hue possible (see plates 2, 3, 4). In addition to the color of Type IV armor shown on vases and in Etruscan paintings, Hellenistic Macedonian tombs offer detailed color images of warriors wearing Type IV armor. Three examples stand out: the tomb at Agios Athanasios, the Great Tomb at Lefkadia, and Tomb B under the Bella Tumulus. The Agios Athanasios tomb painting features two warriors in Type IV armor that apparently has been dyed completely purple. They wear different colored tunics underneath, blue and white respectively, and yellowish-gold *chlamys*. A painting on the facade of the Great Tomb at Lefkadia shows a warrior wearing Type IV armor in which the shoulder piece is a reddish purple while the majority of the body is white; a square chest portion of the armor is colored the same reddish purple as the shoulder piece, as well as a thick band that encircles the midsection, ending before the beginning of the *pteruges*. The tunic is reddish purple, and the color of the *chlamys* resembles that of those in the Agios Athanasios tomb. The warrior in the Bella Tumulus has multihued Type IV armor similar to that of the warrior on the Great Tomb; his shoulder piece is light purple, while the rest of the armor is white. His tunic is light blue, and he holds a red *chlamys* wrapped around his body. While these images may represent the armor of particularly wealthy individuals, such boldly colored depictions of Type IV armor demonstrate that color alone cannot be reliably used to identify what material was used in Type IV armor.

When looking at the vase painting evidence, Jarva tentatively suggests that changes around the fifth century B.C. from predominantly lighter hues to darker ones might indicate a shift from mostly linen to leather armor, but he himself admits that this is extremely speculative. Ultimately, one must conclude that, owing to the many uncertainties raised by changing artistic conventions, the problems with taking the colors in these images literally, the wide range of colors that both

linen and leather naturally possessed, and the possibility of painting armor, color alone cannot be used as a reliable diagnostic tool in interpreting the composition of a given item of armor depicted in a piece of art.

One other characteristic visible in vase paintings might help indicate whether the armor is made of linen or leather. In most images, there is a strong horizontal line separating the *pteruges*, or flaps, from the main body of the armor, giving the impression that the flaps are separate pieces attached in some fashion around the bottom edge of the armor. In some images, however, the *pteruges* are drawn so that they appear to be continuous projections of the armor itself rather than separate components. In these examples, there is no horizontal dividing line, and the *pteruges* flow seamlessly into the armor, implying that they are all composed of one continuous material. When we constructed our replica linothorakes, we made the *pteruges* as separate components of a different thickness from the main body armor and attached them individually.

If, however, one were cutting out Type IV armor from, for example, a large oxhide, the simplest procedure would be to cut out the main body and *pteruges* as one big piece and then simply make a series of vertical slits extending up from the bottom edge to produce the *pteruges*.[13] It is additionally suggestive that in most of these types of images there is only a single row of *pteruges,* because it would not be possible to create the often-seen double-row variant using this method. Although there is no way to be certain, the distinctive appearance of the armor on these pots could be explained by its construction from a single piece of hide, implying that at least these examples of Type IV armor (admittedly a minority) might have been made of leather.

Sewn versus Laminated Construction

The next two possibilities for the material from which Type IV armor was made assume that the Type IV armor seen in iconographic images can be identified with the linothorax (or the *thorax* of linen) mentioned in literary sources. Thus, the literary terms themselves provide the key information about the composition of Type IV armor. This has the advantage of matching up a type of armor attested by a significant body of literary evidence with a type of armor observable in an even larger corpus of visual images. The argument then becomes whether the linen consisted of layers of fabric sewn or quilted together with stitching or whether the layers were laminated together with glue.[14] In favor of the quilted hypothesis, a few early vase paintings can be cited in which the surface of the armor features a cross-hatched pattern of lines, which could be interpreted as the sort of stitching com-

monly seen on quilted objects. An additional question is whether the sewn layers were just left as is, or whether some material, such as fabric scraps or wool, was stuffed between the layers. That such quilted, stuffed armor could be functional as protection is attested by comparative historical evidence from societies that used variants of quilted armor: for example, the Aztecs and some later medieval European soldiers are known to have worn quilted jerkins.[15]

Against the quilting hypothesis is the fact that most paintings show a smooth surface to the armor, with no trace of stitching lines.[16] Also hard to reconcile with the visual evidence is the stuffed and quilted style of construction in which the pockets between layers were stuffed with some sort of material such as wool, hair, or linen scraps in order to increase resistance to cuts and punctures, as is typically the case with quilted armor from other historical periods. Such stuffing should produce a markedly puffy or bulging appearance that is not evident in the visual depictions, which overwhelmingly suggest a uniform, smooth surface. Many of the most detailed visual images (e.g., the paintings from a tomb under the Bella Tumulus and from the facade of the Great Tomb at Lefkadia) depict Type IV armor that is form-fitting and could not possibly be stuffed. Stuffing would also make the armor itself fairly thick, but the paintings seem to indicate armor that is, at most, no more than 1 or 2 cm thick, leaving little room for stuffed, quilted layers. For these two reasons, the visual evidence seems to rule out the possibility of stuffing.

One alternative arrangement could have been that the layers were not stuffed and were stitched only along a few key seams. In such a case, the stitching might have run along seams only at the edges of the fabric panels rather than in the more familiar crosshatched pattern. A potential challenge to this idea is whether such an arrangement would impart the rigidity clearly observable in the vase paintings. This is especially true for the images that present the shoulder flaps standing stiffly erect before they have been pulled forward and down across the chest.

Another freestanding, self-supporting component of Type IV armor is the rectangular flap that extends up from the shoulder section to cover the back of the neck (fig. 3.3). This pronounced feature of Type IV armor is obviously intended to protect the wearer from sweeping horizontal blows aimed from behind at the vulnerable gap between the helmet and the main body of the armor. To make this flap freestanding as shown in the illustrations, the material of the Type IV armor must have possessed a fairly high degree of rigidity. Would even many layers of sewn or quilted fabric impart the requisite stiffness to these two pieces of the armor? Much depends on the nature of the fabric itself and whether it had undergone chemical treatment that might render it stiffer. Our experimental reconstructions prove that many layers of untreated linen could have attained such

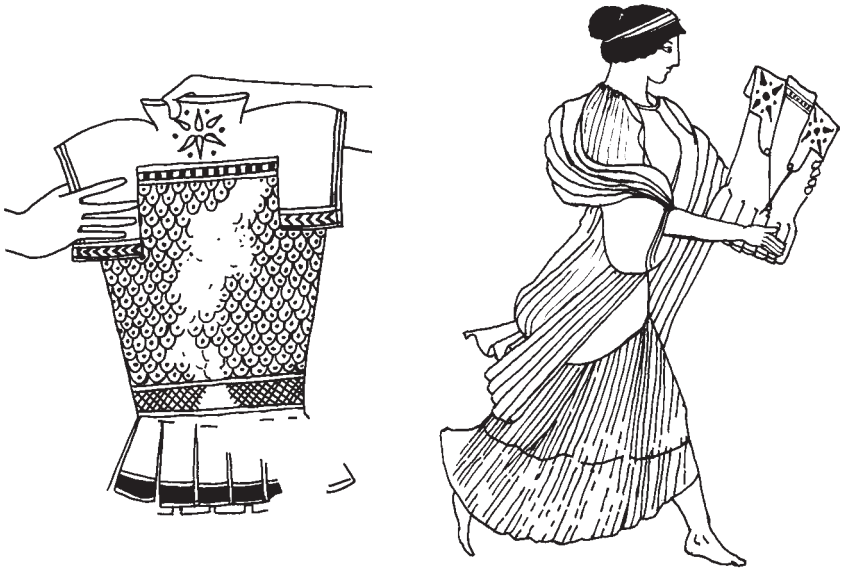

Fig. 3.3. Odysseus giving Achilles' armor to Neoptolemos, on an Athenian red-figure cup by Douris. Note the neck flap, the six-point star, and the rounded scales (*left*). Woman carrying a Type IV corselet (*right*). (*Left*, R-52; *right*, R-152)

rigidity. Therefore, Type IV armor made of unstuffed, sewn layers of linen is a possibility that would not be incompatible with the visual and textual evidence.

A second suggestion that has been offered for how linen might have been made strong enough to serve as effective armor is that the fabric was subjected to some form of chemical treatment to increase its stiffness, thereby supposedly enhancing its resistance to penetration. The most commonly proposed treatment is to soak the fabric in a mixture of vinegar and salt. The origins of this idea lie in a 1647 commentary on Suetonius by Isaac Casaubon. When discussing the linen breastplate of Galba, Casaubon quotes a text of the Byzantine historian Nicetas Acominatos dating to 1204–10, which claims that Crusaders were able to create weapon-resistant armor by treating linen corselets with salt and vinegar.[17] While no text attests to such a procedure having been used on linen in the ancient world, there is evidence of an analogous treatment for wool. Pliny the Elder comments that the Gauls and Parthians allegedly made a fabric resistant to cutting with iron by soaking a type of wool in vinegar (*Natural History* 8.192). Modern experiments attempting to replicate the Byzantine process have not been very successful, but vital nuances of the procedure may well have been lost.[18] Although this suggestion is

intriguing, it cannot be regarded as a definite (let alone common) ancient practice unless the process can be replicated or further information is discovered.

A final option, and the one that we ultimately came to favor, is that Type IV armor was composed of multiple layers of linen laminated together with some sort of glue to form a single, thick slab. The suggestion of laminating layers of linen appears to have first been put forward by Peter Connolly, who reported that he used this technique to reconstruct a cuirass.[19] Supporting this approach is evidence, both archaeological and textual, that such lamination technology involving fabric was known and available in the ancient world.[20] A small fragment of laminated linen containing 14 layers has been found in a grave at Mycenae among a cache of arms and armor (Studniczka 1887). This was interpreted as a piece of an actual linothorax, although it could also have come from another type of laminated armor, perhaps cloth greaves. Similarly, a piece of laminated linen uncovered at Tarquinia was identified by the excavator as having originally been part of a linen corselet (Helbig 1874). Admittedly, given the fragmentary nature of these finds, one cannot definitively state that they came from body armor, but they do suggest that inhabitants of the ancient world were laminating linen, and the context of the finds among arms and armor suggests that lamination had military applications.[21] The Greeks also seem to have employed such laminated linen technology to other well-known areas of their culture. Currently ongoing research by Prof. Amy Cohen of Randolph College asserts that the masks worn by actors in Greek theater were constructed out of laminated layers of linen.[22]

Type IV construction employing laminated linen layers would fit the visual evidence gathered from paintings and sculpture. In both vase paintings and wall paintings, Type IV armor is frequently depicted as having a smooth, white appearance. Such a texture and color could be obtained from bleached and laminated linen, although these could also be the result of paint. Laminated linen layers would also account for the unusual combination of rigidity and flexibility observed in the images. If laminated, 10 to 20 layers of linen would possess the necessary rigidity but could also be bent into the required tubular and curved forms. One of the criticisms that has been voiced against the use of laminated linen is that the stress of bending the laminated product to the degree seen in the paintings would cause the layers to delaminate or even rupture. This is a legitimate concern that can be resolved only through practical experimentation with the sorts of fabrics and glues available in the ancient world, a process that is described in chapter 4.

A second and more sweeping criticism (that also applies to sewn or quilted armor) is the widely held contention that any armor made predominantly out of linen could not have provided sufficient protection to its wearer to be credible. For

example, in his excellent discussion of the arms found in the Royal Macedonian tombs, Eugene Borza offers just such an offhand rejection of the potential of linen armor. When referencing the ancient sources' claim that Alexander wore Darius's captured linen cuirass at the Battle of Gaugamela, he reinterprets this item as being merely decorative in nature and asserts that both Alexander and Darius must have worn it over a "normal breastplate." Without presenting or discussing any evidence, he hastily condemns linen armor with the words, "The linen *thorax* cannot be considered as a serious and effective protective device."[23] Such dismissals are at odds with the literary evidence already cited, which testifies to the long and widespread use of linen body armor. Furthermore, in a large number of cases, it is not the poor or nonprofessional soldiers who are said to have been equipped with linen armor but rather the officers, generals, and elite warriors; this suggests that linen armor was not regarded as fundamentally inferior to or less desirable than other available types of armor.

Composite Construction

The fourth hypothesis for Type IV armor is that it was a truly composite form that employed metallic elements together with textiles and/or leather. The visual evidence confirms that such composite forms did exist. Of the 913 images of Type IV armor, 201 show scales attached to an underlying material, and these scales are usually assumed to be made of metal.[24] These paintings and sculptures occasionally depict scales covering nearly the entire exterior surface, but far more common are images in which scales extend only over specific regions. Most typically, there is a band of scales circling the lower section of the wearer's torso corresponding to the vulnerable zone between the ribs and the groin. It would have made perfect sense to reinforce this area because a penetrating thrust to the abdomen in the era before antibiotics nearly always resulted in a fatal infection due to either the introduction of dirt and debris into the wound or the perforation of the intestinal tract or other organs. Thus, it can be said with confidence that one subset of Type IV armor was of this sort, in which scales were used to add an extra element of protection. The question remains, however, whether that underlying material was leather or linen, and all the same arguments pro and con discussed earlier then come into play.[25]

An interesting possible form of composite armor is one made of a combination of linen and leather. For example, a core of stiffened leather might have had several layers of linen sewed or glued around it, creating a truly hybrid armor. Such composite armor might have had metal scales attached to the exterior. This is an intriguing possibility, and it seems reasonable that ancient peoples would have at least

experimented with such a composite form, but there are no explicit mentions of such a hybrid form in the literary sources. Thus, this form of construction is entirely a modern hypothetical creation. In artistic depictions, there is no reliable way to distinguish this sort of composite armor from examples that were either all linen or all leather. In any event, it seems doubtful whether such armor would have been markedly superior in terms of performance, wearability, cost, ease of manufacture, and protective qualities when compared to armor made from only one material.

Finally, the fifth theory is that the leather or linen was merely a superficial and decorative external coating over metal plates, which formed the core of the armor and which accounted for nearly all of its protective qualities.[26] Such a construct would be somewhat similar to some types of modern military body armor that incorporate (often removable) rigid plates within a more flexible fabric-like shell. If the Type IV armor were of this sort, one might expect to see in the artistic depictions the outlines of these metal plates as visible bulges on the surface of the armor, or at least the patterns of stitching which held them in place. Such indications are never visible, however. Additionally, it is hard to reconcile the smooth bending of the armor observable in both scenes of warriors preparing for battle and fully attired in Type IV armor with the presence of large, rigid metal plates within the armor. Above all, if this were a common type of armor, one would expect that many more examples would have been found rather than the single questionable case discussed below. In reality, the origins of this theory seem to stem not from any ancient evidence, either literary or visual, but instead once again from a basic refusal to accept that leather or linen alone could have offered credible protection to its wearer. We believe that our reconstructions and the tests that we performed (discussed later) amply demonstrate that even linen alone can give excellent protection to its wearer.

Often mentioned in connection with the idea of Type IV armor being made of metal plates with a superficial linen covering is the famous all-metal cuirass found in the Macedonian royal tombs at Vergina.[27] This piece of armor is unique in a number of ways. It is constructed of iron, not bronze, with gold trim and fittings, and consists of several solid plates connected to one another with hinges. In form, it is nearly identical to Type IV body armor, with the same combination of body and shoulder pieces. In appearance, it seems to be exactly the Type IV linen or leather cuirass translated into an iron version. Although this find is still incompletely published, there are indications that cloth panels may originally have been attached to both the inner and outer surfaces of this cuirass, although in what manner or how extensively remains unclear.

In the end, the Vergina cuirass seems most likely to be a one-off piece of

ceremonial armor created for royalty, which confirms that the basic shape of Type IV armor was a familiar one and also demonstrates that it was possible to produce an all-metal variant of this armor. While sharing the same basic shape with Type IV armor, it cannot be the armor in the ancient illustrations because its inflexible plates could not have been bent or curved in the characteristic manner observed in the paintings. Most scholars have concluded that this was an atypical piece designed for royalty or as a grave good and therefore not representative of a standard armor type of the time.[28]

From this review of possible materials used to create Type IV armor, we can draw the following conclusions:

1. From literary evidence, we know that many ancient cultures, including the Greeks, fashioned armor (*thorakes*) made of linen. At least some of the visual depictions of Type IV armor are likely of this type, the linothorax.
2. Whether this armor was made of layers of sewn-together or laminated linen cannot be determined from the evidence, although for various reasons, laminated linen seems more likely.
3. It is possible, even probable, that some examples of Type IV armor were alternatively made of leather, and the images in which the *pteruges* seem to have been cut out continuously from the main body of the armor are perhaps most likely of this construction.
4. Unfortunately, it is not possible to definitively distinguish linen from leather in most visual depictions of Type IV armor.
5. A subcategory of Type IV armor did feature metal scales applied to a core of linen or leather.
6. Some Type IV armor may well have been constructed from a combination of materials. It is unlikely, however, that the principal component of such composite armor was metal plates with a superficial covering, although the Vergina tomb cuirass suggests that all-metal versions of the Type IV form of armor were possible.

While these statements may appear somewhat inconclusive, it must be remembered that there was much less standardization in the ancient world than we are accustomed to in the modern age. At various places and times, a particular craftsman (or craftswoman) almost certainly made individual suits of Type IV armor out of anything and everything that happened to be available at that moment. Because every suit of Type IV armor was, in essence, a handmade, unique creation, we simply cannot assume a rigid degree of standardization across all cultures and time

periods. Therefore, to make a blanket statement that all Type IV armors were made out of linen, or leather, or anything else, would be foolish and unrealistic. But on the basis of literary and visual evidence and issues of practicality, it does seem safe to say that linen and leather are the most likely candidates as the main materials of which Type IV armor was composed.

When attempting to determine which was more common, however, an overwhelming amount of textual evidence favors linen. There are at least 40 extant quotations from 24 different ancient authors (all of whom wrote during the period when Type IV armor was in use) that explicitly testify to the existence of a kind of *thorax* made out of linen, and additional suggestive sources point to the same conclusion. Against this, we have a single tenth-century A.D. paraphrase of a second-century A.D. source claiming that there was a *thorax* made out of leather, and several ambiguous citations. Probably both varieties did exist, but the weight of the literary evidence argues for linen. Leather may even have been more prevalent in certain regions and at certain times, but such a statement is purely speculative. The available sources do indicate that Type IV armor made out linen was a familiar item around the ancient Mediterranean over a long time-span. Because the evidence for Type IV armor having been made of linen is stronger than that for leather, we believe, generally speaking, that Type IV armor made of linen was the dominant form.

Furthermore, we believe that when choosing between a Type IV corselet made of laminated layers of linen and one made of sewn-together layers of linen, ancient warriors would have preferred the laminated version. This is because laminated linen provides better protection for the wearer against two different types of attacks. As discussed in chapter 6, our tests revealed that, when transformed into a solid slab through lamination, a given number of layers of linen provided greater resistance to penetration by sharp, narrow points such as arrows or spear tips than the same number of layers of linen that had been sewn together. Admittedly, the increase in degree of resistance to penetration of laminated versus sewn armor was not overwhelming (about 15%), but it was significant enough to be a consideration.

Where the two types of armor would have differed dramatically was in the protection that they gave the wearer against nonpenetrating blunt force blows. If a warrior equipped with a corselet made of sewn-together layers of linen were struck by a mace, ax, edge of a sword, or even a spear point that did not penetrate, a large amount of the force of this blow would be transmitted directly through the soft fabric of the armor to his body at the point of impact. If, however, he were wearing a laminated Type IV corselet, the glued-together layers would constitute a hard shell that would disseminate the force of the blow over a large surface area, protecting the soft tissues within. It is equivalent to the difference between striking

someone wearing a soft hat over the head with a hammer and hitting a person wearing a protective motorcycle helmet. Both will feel the blow, but the experience is likely to be fatal for the former, whereas only temporarily disorienting for the latter. This protective advantage of laminated linen would also have applied when comparing it to forms of Type IV armor made out of unhardened leather.

For all of the reasons discussed in this chapter, while we believe that there were many different variants in terms of material and construction methods used to make Type IV corselets in the ancient world, our default, normative model became the laminated linen one. Thus, it was this form upon which we concentrated our efforts, first to replicate and then to test.

Reconstructing the Linothorax

Although the literary and artistic evidence confirms that some sort of linen body armor of the Type IV pattern was widely used in the ancient world, many uncertainties about its form and construction remain. Chief among these are whether it was quilted or laminated, the exact shape of the armor, and how it would have performed in the field. In order to gain insight into these practical questions, we attempted to reconstruct full-scale examples of the armor. We decided to focus first on the laminated linothorax, as our interpretation of the visual evidence suggested that it was more common. Compared to garments made from more familiar materials, such as leather or quilted fabric, laminated linen constituted a more mysterious type of construction process and thus one about which reconstructive archaeology could potentially offer greater insights.

Developing a Basic Pattern

The first step in our reconstruction was to develop a pattern for the two main components of Type IV armor that, when worn, would produce a corselet of the same appearance as those seen in paintings and sculptures. To construct armor whose shape was identical to these images involved considerable trial and error, employing mockups made first out of heavy paper and then cardboard. Eventually we settled on a basic design. The shape was surprisingly complex, with a number of curves and cutouts, but experimentation revealed that nearly all of these served practical purposes. For example, between the two arms of the shoulder piece is a small, rectangular tab. When the two long arms of the shoulder piece are pulled down over the shoulders, this tab remains standing upright, forming the distinctive neck-guard seen in the vase paintings. Thus, in the design, what initially appears to be a superfluous feature ends up serving a vital practical function: protecting the vulnerable gap at the back of the wearer's neck.

We initially constructed the main section that wraps around the body not as being straight across the bottom edge, but instead as curving upward approximately 5 cm on both the right and the left sides. When we wore the armor, we found that these slight indentations allowed a much greater ability to bend one's body to the

right and left than if the bottom edge had been straight. In addition, having the bottom edge dip down in the front and back affords those regions greater protection from low spear or sword thrusts. This shape is similar to that seen in the Type III muscle cuirasses, and is a logical way to maximize protection. These curves are somewhat hidden in the final product by the *pteruges*, or groin flaps, which are of different lengths but are attached so that their lower edges hang from the main body piece in an even row. Once we had done a more complete analysis of the vase paintings, however, it seemed that the majority of these depicted a straight edge across the bottom of the armor, and so our later reconstructions followed this pattern. Our final pattern was of a somewhat simplified design with a straight edge across the bottom (fig. 4.1). Depending on how the *pteruges* were attached, however, a curved bottom edge could easily be concealed in the paintings, and the practical advantages of this design seem self-evident.

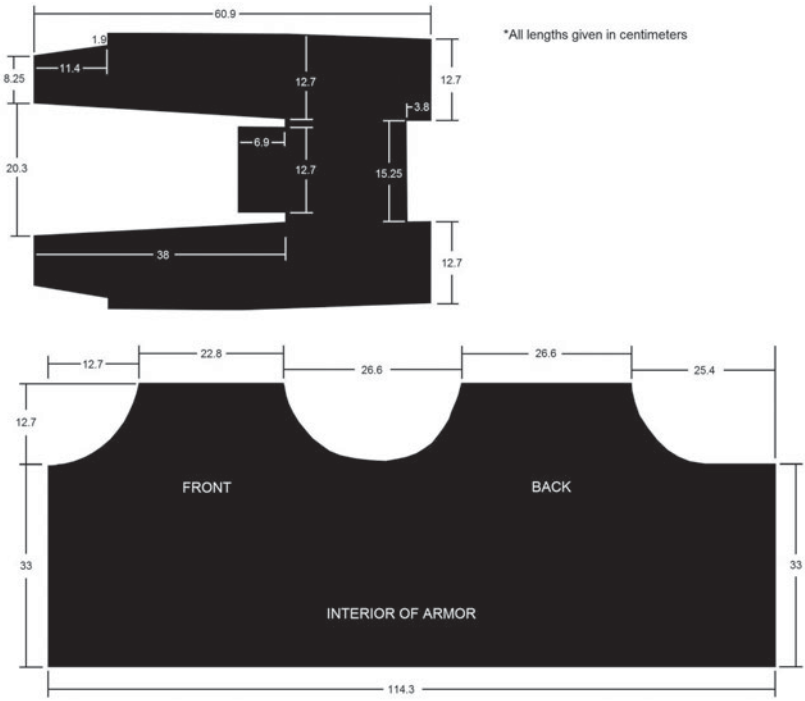

Fig. 4.1. Final linothorax pattern (with measurements in centimeters). Our first pattern was the most complex one, which became increasingly simplified, resulting in this final version.

Because most depictions of Type IV corselets in ancient art portray them without scales, we decided to concentrate on this "basic" form in our own reconstructions. Scales were a not uncommon addition to ancient Type IV armor, but they would have introduced numerous problematic variables, such as thickness, placement, attachment method, and the metallurgy of their composition. This decision was also made easier because we did not have ready access to a blacksmith skilled in ancient Greek techniques of metalworking. Thus, the six complete linothorakes that we have made so far, although each different in minor ways, are all of the basic design without added scales or plates.[1]

One subject of debate was whether the two long arms of the shoulder piece should be parallel, as in our pattern, or whether they should splay outward at a slight angle, as observed in some ancient images of arming warriors (see fig. 1.1). Additionally, in some iconographic depictions, when the two arms are tied down, they converge toward the center of the wearer's chest. This would be possible only if the arms were not parallel but angled. We experimented with this feature quite a bit, and in the end, there seemed to be two possible main styles: with a single, central attachment point, the two arms tend to converge more dramatically, and the splayed design works better; with a widely separated attachment point for each arm, then the design with parallel arms is more functional (fig. 4.2, left).

Although in practical terms splayed shoulder pieces work well with a central attachment point and parallel ones with two widely separated attachment points, there are some vases that show a combined style, with two attachment points and splayed arms, in which the laces cross over one another. Thus, the lace attached to the wearer's right-side shoulder flap is tied down on the left side of the wearer's chest, and vice versa (fig. 4.2, right). These variations did not seem to conform to any chronological or geographic pattern. The images illustrate that there was plenty of leeway for overlap among the styles. In our reconstructions, the width of the wearer's shoulders emerged as a relevant factor that might have affected the choice of style. It seemed that parallel flaps with two attachment points created a more comfortable fit for broad-shouldered individuals, whereas the single attachment point with splayed flaps worked better on those with narrower shoulders. Both main styles are amply attested in ancient art.

Once we had developed the basic pattern, we discovered that we could easily adapt the style for individuals of widely disparate body types by simply adding or subtracting centimeters from the straight sections on the right and left sides of the main body piece and similarly adjusting the length of the arms of the shoulder piece. All the complex parts of the pattern could remain exactly the same. By

Fig. 4.2. Etruscan incised bronze cist depicting a warrior with parallel shoulder flaps going to separate attachment points on the chest (*left*). Etruscan incised bronze cist showing a warrior with splayed shoulder flaps and crossed-over attachment points (*right*). (*Left*, M-66; *right*, M-68)

altering just those three measurements, the same pattern was used to make a linothorax for an individual with a 96 cm (38 in.) chest and another for someone with a 122 cm (48 in.) chest. Likewise, the armor can also be significantly tightened or let out to fit different body sizes, without adding or subtracting fabric, through variations in the lacing. Much as with the lacing on a shoe, the armor can be made smaller or larger by tightening or loosening the ties on the sides and where the shoulder flaps are attached to the chest. We suspect that in the ancient world, this type of armor was probably made in a few basic sizes corresponding to small, medium, and large, and then within those sizes, it could easily have been fine-tuned by using the laces to achieve a perfect fit. This flexibility provided a major advantage over conventional metal cuirasses, which had to fit an individual wearer precisely, and are difficult or impossible to alter if the wearer gains or loses weight or if the armor is transferred to another person.

Potential evidence for just such a procedure in the ancient world survives in the form of 11 lead tokens found in the Athenian Agora, at least some of which were associated with a third-century B.C. deposit of records concerning the Athenian

cavalry.[2] These lead disks are stamped on one side with a depiction of what appears to be a Type IV corselet and on the other with a capital Greek letter. The *epomides*, or shoulder flaps, are clearly visible, and there are what seem to be four horizontal bands, perhaps representing rows of scales, across the torso section of the corselets. There are two distinct layers of *pteruges* of unusual length. The shortness of the torso section of the armor coupled with the extra-long *pteruges* would be an eminently practical design for corselets especially intended for use by the cavalry.

These eleven coinlike lead disks form part of a much larger body of such tokens, others of which are stamped with images of helmets, greaves, and shields. Collectively they have been identified as quartermasters' tokens, given to members of the Athenian militia that enabled them to present the token and then draw the item represented from public storehouses of arms and armor.[3] The letters on the backs of these tokens are thought to have been indications of size.[4] The helmet, greave, and corselet tokens are marked with alpha, gamma, or delta, whereas the shield tokens bear only alpha notations. Presumably the letters represented the equivalent of "small," "medium," and "large," although the correspondence of letter to size is unknown. Because helmets, greaves, and corselets needed to be fitted to individual body types, whereas the same size shield could be used by all soldiers, it is logical that tokens for the first three items are found stamped with all three letters, whereas the shield tokens bear only the alpha designation. If the interpretation of these tokens is correct, it would seem that Type IV corselets were at times manufactured in a range of generic sizes which could then be ready for issue in bulk in order to quickly outfit the soldiers of an army.

Fabrics and Glues

Having settled on a pattern for the armor that was both practical to wear and consistent with the ancient evidence, we were ready to begin construction. Ideally, we would have liked to employ only fabric and glues that were as close as possible to those available to the inhabitants of the ancient Mediterranean. In terms of textiles, this would have meant obtaining linen made from flax plants that had been grown, harvested, and processed using only traditional methods. The linen widely available today is made from flax plants that have been harvested by machines and then processed with chemicals, which gives it substantially different properties from the linen of the ancient world. In order to approximate the methods used in the ancient world, the resulting fibers would also have to be handspun into thread and handwoven into fabric. Eventually we were able to obtain such linen, but, as might be expected, the cost of this fabric was extremely high.[5] Currently a project of planting

and growing several plots of flax is underway at our university. The resultant plants were retted, scutched, and hackled with traditional implements, and the fibers extracted were spun into thread using drop spindles and then woven into linen. In the future, this may provide us with a ready source of linen that is at least reasonably similar to what was available in the ancient world.

While we determined that it would be necessary to use traditionally processed linen for the penetration tests assessing the protective qualities of the armor, for practical reasons of budget we decided that we would construct our full-scale replica linothorakes out of fabric that was not entirely handmade. Because the main goal of the reconstructions was to test issues of design and wearability, this seemed an acceptable compromise. Almost all of the textiles (whether traditionally produced or processed by modern methods) that we employed in both reconstructions and test patches were a plain tabby weave.[6]

We also experimented with a variety of glues, both ancient and modern, in order to see whether the type of adhesive used had a measurable effect on the level of protection offered by the armor. The main glues employed were traditional animal-based and modern PVA glues. The choice of which ancient glues to utilize presented several problems. We unfortunately know little about the sorts of everyday glues that were used in antiquity. Although archaeological discoveries leave no doubt that inhabitants of the ancient world concocted complex recipes for "superglues" with impressive adhesive properties, we were concerned that many of the required ingredients might have been either too hard to get or prohibitively expensive for them to have been regularly applied as common adhesives.[7] Even when it is possible to identify the individual ingredients in surviving samples, modern researchers have not been able to rediscover or replicate the process for mixing these glues, so in our experiments we could not make use of them. If linen armor was indeed worn as extensively as we believe, we wanted to employ glues that would have been similarly widely available. Such glues were probably most frequently made from the skins of animals. For example, Pliny the Elder identifies two common categories of glues: those made from animal parts and those made from fish (7.56, 16.79, 28.71, 32.24).

Ultimately, we decided to experiment with glues that were widely available, easy to manufacture, and inexpensive. One was an animal-based glue, made from the skins of rabbits, an adhesive that is still employed today by some artists who paint according to traditional methods; and the other was a simple plant-based adhesive produced from the seeds of the flax plant. The ubiquity of rabbits and their relatively cheap cost compared to other types of animals made rabbit glue an appropriate choice, as it would have been both accessible and affordable to almost

any inhabitant of the ancient world. In the same way, flax seed glue was particularly attractive since it allowed us to state confidently that anyplace where flax could be grown in order to produce linen would already have possessed the raw materials needed to make the glue.

While the field performance of the glues was similar, there were differences in their ease of use during the construction process. The modern glues were unproblematic to work with, but the ancient ones each presented unique challenges. In its commercially available form, rabbit glue consists of a powder that has to be soaked overnight in a large quantity of water and then raised to a gentle boil in a double boiler. When ready to be applied, it has a thin, watery consistency, so that in order to achieve a sufficient bond, the fabric has to be thoroughly soaked with the glue. The glue is then applied with a brush or squirted directly onto the linen using a baster. Once two layers of fabric are saturated, they have to be dried, and as the excess water evaporates, the layers slowly bond together (fig. 4.3).

We initially encountered some problems getting the layers to dry, which was partly due to working in a relatively high-humidity basement setting. Under these conditions, a noxious mold began to grow on the layers before they dried. This mold interfered with the bonding process and would have rendered the armor unwearable because of the stench (and probably hazardous to the health as well). After some experimentation, we found that this could be prevented either by the addition of a small amount of vinegar (a common ingredient in ancient glues, perhaps for exactly this reason) to the glue mixture or by suspending the patch from a line so that air could circulate around it freely during the drying process.[8] The flax seed glue was made by gently boiling a mixture of seeds and water until it reached a gummy, mucus-like consistency. The seeds were then strained out, and the viscous substance quickly applied before it could harden. The flax seed glue was more difficult to work with since it had to be applied in a narrow window of time when it was just the right consistency.

Although all the glues formed a firm enough bond to hold the layers together, even when being sharply bent from a flat to a C shape, and to keep the patches bonded together over time, it was clear that the flax seed glue formed the weakest bond, and it was possible for a person to pull apart a patch made with this glue into its constituent layers. The rabbit glue was next strongest, roughly equivalent to modern household glues such as Elmer's, and some more heavy-duty modern glues were better still. We suspect that, in reality, ancient makers of this armor probably employed more complex glue recipes that produced a strong bond on par with that obtained with the heavy-duty modern glues, but we did not want our

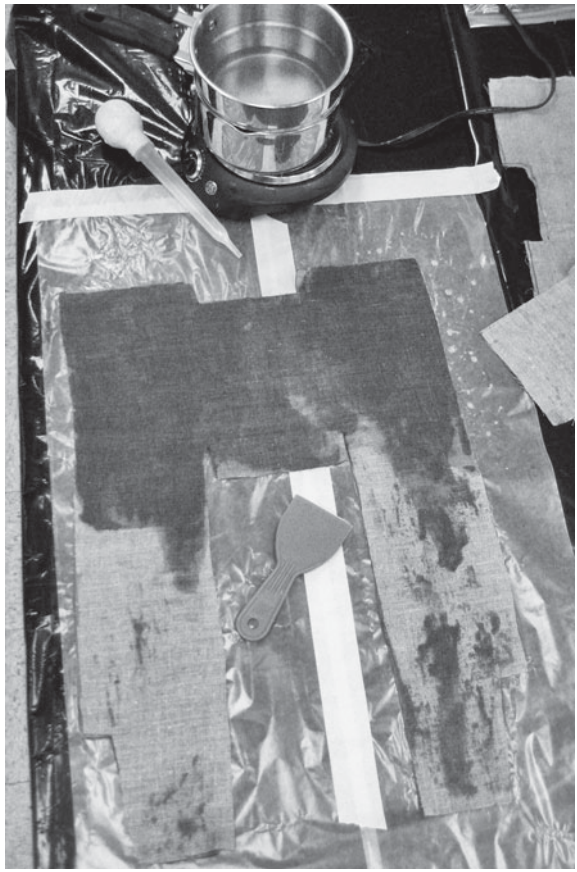

Fig. 4.3. Applying rabbit glue to a layer of the shoulder section. The rabbit glue was dissolved in the double boiler, applied with the turkey baster, and spread with the putty knife. Glue has been applied to about half the piece of linen, and this photo suggests the fabric's heavy degree of saturation with glue.

conclusions to hinge on the hypothetical existence of a historically unattested or unreplicatable adhesive. What our successful use of rabbit and flax seed glue established is that almost any inhabitant of the ancient world could have constructed such armor with readily available and inexpensive glues. Ultimately, we put together six complete replica linothorakes and several dozen test patches in order to assess various features of the armor, and these different examples ranged in historical authenticity from ones assembled out of modern linen and glue to ones that were constructed out of the sorts of materials that were as close as we could make them to those which would have been available in the ancient Mediterranean.

The Lamination Process

The basic lamination process used to construct the two main parts of the linothorax was straightforward. A thick layer of glue was spread onto a piece of fabric until it was saturated, and then another layer of fabric was placed on top and pressed onto the bottom piece. In general, we discovered that the finished product was strongest when enough glue had been applied to saturate both layers. The laminated layers were allowed to dry, which usually took 14–20 hours, and then the procedure was repeated until the desired number of layers was reached. We found that it was not necessary to press the layers under a weight during the lamination process. For tests that were concerned with evaluating design issues, we employed primarily modern animal based glues and polyvinyl acetate (PVA) glues in our reconstructions, whereas when measuring the performance of the test patches, we used mainly more "authentic" rabbit and flax seed glues.

When fabricating the two main sections of the linothorax, there were two possible methods: laminate together large rectangular pieces of linen until we built up two flat slabs of the desired thickness, trace the patterns for the two pieces onto these, and then cut out the components; or cut each individual layer of linen into the desired final shape first, and then carefully glue all of these together. We made at least one linothorax using each process. The procedure in which each layer was first cut to the final shape before gluing required greater meticulousness and skill, because the layers had to be precisely the same size and shape as their fellows (fig. 4.4) and then layered and glued exactly, one on top of the other. When the fabric was soaked in glue and then dried, there was also a slight expansion and contraction in size, which added to the complexity of the process. Finally, there was a tendency along the edges for the layers either to separate or not to adhere as thoroughly as those areas in the center of a slab, and this, together with the inevitable slight differences in measurement among layers, resulted in a ragged appearance of the edges.

We found that it was useful to cut each piece slightly larger than was desired in the final product, giving us a margin of error on the edges. The excess could then be trimmed at the end to reduce the ragged effect. There were two main advantages to this method of construction: cutting a single layer of linen into the desired shape is easy and only requires a tool capable of cutting a single layer of linen; and because the pieces were precut before assembly, it used the least possible amount of fabric, with a minimum of wastage, which might have been a consideration in reducing the cost of the armor.

The second method was to construct two large, rectangular slabs of laminated fabric, trace the patterns onto these, and cut out the pieces from them.[9] There was

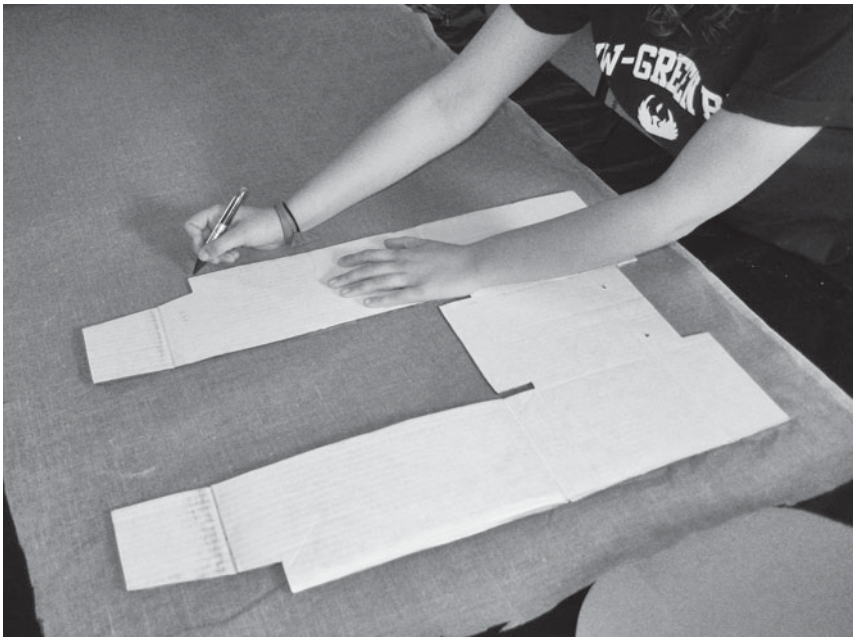

Fig. 4.4. Tracing around cardboard pattern onto linen in order to create a layer of the shoulder piece. After trying different methods, we concluded that the fabric was most likely cut to shape prior to lamination.

less skill required this way because, in building up the large rectangles, there was no need to worry about measuring them precisely or lining up the edges carefully. This method also tended to result in a solid, uniform bond between layers. Because all edges were cut cleanly out of the slabs, they were more even and did not have the frayed, tattered aspect of those produced using the first method, and the bonding between their layers was therefore stronger. The drawbacks to this procedure were that there was considerable wastage of fabric, and it was extremely difficult to cut through the thick slab of laminated linen layers. In various versions, we used between 11 and 20 layers of linen, producing a total thickness of 8–12 mm. This amount of laminated fabric proved impervious to all standard hand-operated cutting implements that were available to us, including oversized shearing scissors and even a large bolt cutter. Eventually, we had to resort to cutting out the patterns using an electric jigsaw equipped with a blade intended to cut through quarter-inch metal plates.

On the basis of these experiences, we strongly suspect that, in the ancient world, this type of armor was made by first cutting each layer of linen very close to

the final, desired shape and then gluing these together to build up the laminated layers. Given the labor-intensive nature of producing and weaving linen in the ancient world and its higher cost relative to today, this technique would have used less material and thus been significantly cheaper. This construction method would also have consumed less glue, further reducing costs. Finally, when one considers the difficulty that we had cutting the fully laminated layers even when employing very sharp modern tools, one can imagine how much more awkward and difficult it would have been for ancient craftsmen to perform the same task, further suggesting that the first method was probably the one used in the ancient world.

With either method, once the two main pieces of the linothorax had been produced, we found that it was useful to apply one or two final layers of linen that had been cut to the specifications of the pattern, but with at least 4 cm extra added on all sides, to each. This extra fabric was then folded over the edges of the laminated slabs and glued down. These final layers greatly enhanced the aesthetic appearance of the pieces by covering up the visible layers of lamination with a smooth fabric surface and concealing any ragged or uneven edges. It also served a practical purpose by helping to press and hold together the laminated layers at their most vulnerable point, the edges, and to prevent any object from being easily inserted between layers to pry them apart. Covering up the exposed edges of the layers greatly added to the armor's ability to resist damage from rain or other moisture. Because this final layer would have been the only visible one, we suspect that it may often have been made from a finer grade of linen in order to give a smooth outer surface to the final product. Also, if this final layer were made from linen that had been bleached, then the finished armor would have achieved the whitish appearance often seen in artistic depictions of the linothorax. Thus, the internal layers could have been constructed of cheaper coarse, unbleached linen, but if this last layer were of finer stuff, it would have imparted a more luxurious look to the entire set of armor (fig. 4.5).

Constructing a 17-layer linothorax of 1 cm thickness required a bolt of linen 17 m long and 1 m wide, and the lamination process consumed roughly 7.5 l of glue. When dried, the glue and fabric were stiff but still had enough pliability so that a flat piece could be bent into a C shape without either the slab cracking or the layers coming unglued. When the two main pieces were finished, we joined them together in the region of the upper back using metal bolts, but in the ancient world, these could have been laced together, attached with metal nails or tacks, or even glued.

A final distinctive component of most Type IV armor was one or two rows of flaps, or *pteruges*, that hung from the bottom of the main body piece. In the visual images, these *pteruges* occur in two main varieties: a double row of flaps in which

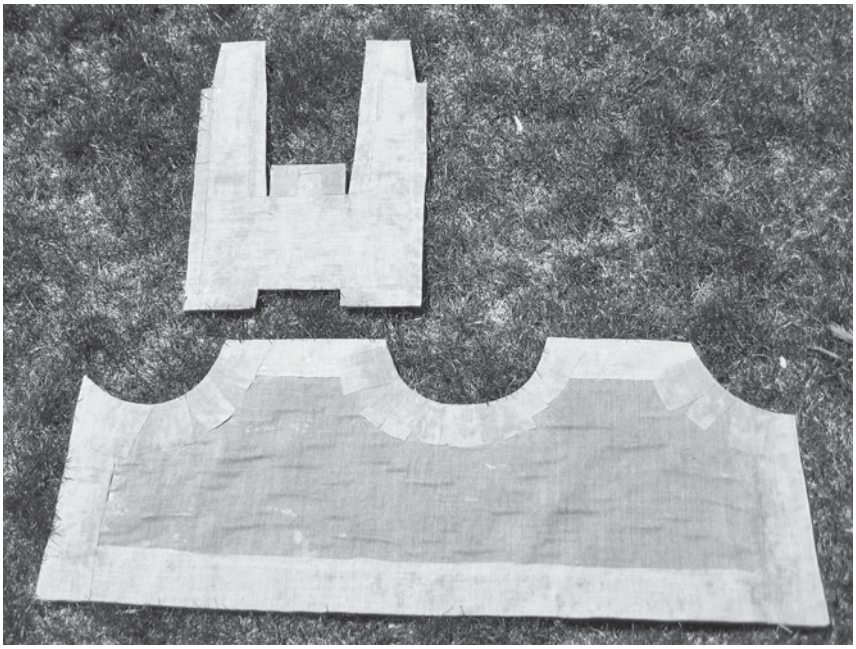

Fig. 4.5. With the lamination procedure complete, the two main sections of the linothorax are ready to be joined together and to have the *pteruges* attached. The final layer of fabric was cut larger than the others and then folded over around the edges.

the inner and outer layers are staggered so that they overlap, which was more common in earlier variants of the armor; and a single layer in which the edges of each flap touch those of its neighbor, which seemed to become the dominant style later on.[10] The overlapping double-row arrangement would have provided better protection because it lacked the gaps that would have opened up in the single-row version when a warrior moved his legs. Also, in the double-row arrangement, an incoming arrow or weapon might have had to penetrate two layers rather than just one if it struck in a region where the flaps overlapped. In paintings and sculptures, it is difficult to judge the thickness of the *pteruges* relative to that of the main components of the armor. Clearly, the *pteruges* were considerably thinner because they can be seen bending readily, and in order for them to function in the position in which they were affixed, they cannot have been very stiff.[11] However, it was obviously desirable that they be as thick as possible in order to offer the best protection to the wearer. It is also uncertain how these flaps were attached to the main body of the armor. In some paintings, particularly where there is only a single row, there is no seam between the top of the flaps and the bottom of the armor, suggesting that

the flaps were cut out of the same piece of material as the armor itself.[12] Alternatively, they could have been affixed around the interior of the bottom of the main body piece with glue or stitching so that they hung below the armor. As a final possibility, if the flaps were a separate piece of equipment from the armor itself, they could have been attached to something like a belt that the warrior would have strapped around his waist, and then the armor would have been donned over this.[13]

In our initial reconstruction, we decided to emulate the overlapping double-row arrangement with the *pteruges* glued directly around the inside of the bottom edge of the main body of the armor (as shown in plate 6). After experimenting with different thicknesses, we finally settled on *pteruges* made by laminating together five layers of linen as the thickest that they could have been while still retaining full flexibility. Our *pteruges* were 5 cm wide, and we glued them onto the main body in such a manner that, in the centers of the front and back of the armor, the inner row of *pteruges* hung 25 cm below the bottom of the armor, while the shorter outer row extended 20 cm below the bottom edge. In each row, the individual flaps were separated by slightly more than 1 cm. In this arrangement, these flaps seem to have offered the maximum protection to the groin and upper thighs.

Heroic Nudity and Armor Length

The *pteruges* are at the center of another controversy concerning Type IV armor. In our reconstruction, the lower edge of the linothorax's main body reaches down to cover most of the belly of the wearer, ending in the front slightly below the level of the navel and above the groin, and in the back extending to the top of the gluteal furrow, with the *pteruges* then reaching down on all sides to the mid-thigh. In visual depictions, however, the lower edge of the linothorax often appears to end considerably higher, around the region of the bottom of the floating ribs, with the *pteruges* also ending correspondingly higher, often just barely covering the groin. In a few extreme cases, the *pteruges* are high enough that the genitals of the warrior are visible. Such is the case on one of the best-known depictions of Type IV armor, that on the name vase of the Achilles painter (plate 5).[14]

If we take these images literally, then the *pteruges* constituted the only protection over the entire lower belly and groin. Because these are among the most vulnerable zones of the body and because any thrust that perforated the abdominal wall and any part of the lower gastrointestinal tract would almost invariably have been fatal, it is hard to believe that these areas would have been left so exposed. Nevertheless, most scholars and reconstructors have taken these depictions at face value and have claimed that body armor routinely ended at or above the level of

the navel, leaving the lower belly and groin exposed. Often cited in support of this conclusion are a few passages that graphically describe wounds to these regions, suggesting that hoplites would sometimes deliberately aim their spear thrusts just below the bottom edge of their opponents' armor (e.g., Homer, *Iliad* 13.567–69; Tyrtaios 10.25).[15]

A practical consideration is whether the armor needs to end this high in order to allow maximum mobility for the wearer. Preserving the ability to bend the torso forward and sideways has been cited as a reason for the armor ending at a high level (e.g., Jarva, 1995, 33–34). In our experiments, however, we found that even with the lower edge of the main body of the linothorax extending two inches below the navel and thus protecting a good portion of the lower belly, it was still possible to bend forward without difficulty and pick up an object off the ground. We could also bend our torsos comfortably to the left and right, but it should be noted that such lateral movements were easier when wearing the design variant in which the lower edge of the armor curved up several inches on the left and right sides of the body to the level of the hips. When we wore versions lacking these side cutouts, the armor had to end marginally higher in order to allow full flexibility sideways. Even with the straight-edge armor, however, its lower edge still extended down close to the groin area, and the *pteruges* stretched at least to mid-thigh.

Ending the armor at the high level illustrated in some vase paintings and thus leaving such a vulnerable area unprotected seems unrealistic when the lower edge of the armor could easily have been stretched a few vital inches downward without a loss of mobility. Given the overwhelming practical advantages to extending the armor as far down as possible, the exposure of the warriors' genitals in these paintings most likely reflects an artistic convention related to the Greeks' general idealization of "heroic nudity."[16] One has only to think of the great many vase paintings showing warriors violently engaged in battle equipped with helmet, spear, and shield, but otherwise completely naked. To accept such scenes as literal representations of battlefield reality would be absurd, and these images are plainly intended as celebrations of the idealized male body.[17] In the same way, the images of illogically short armor should not be taken as photographically accurate illustrations of military reality; rather, allowances need to be made for the cultural context and mores of the civilization that produced them.

On the other hand, the "short" linothorax is not something observed only on sixth- and fifth-century B.C. Athenian vases, where the obsession with male nudity might be expected to be greatest. Images of Type IV armor from all periods, media, and cultures (including Archaic and Classical, black- and red-figure vases, and Greek and Etruscan works) all fairly consistently show the armor ending

higher on the torso than demanded by physical necessity. The one possible exception to this is Hellenistic Macedonian paintings and sculptures in which the lower edge of the armor consistently appears to reach slightly lower than in other images, and the *pteruges* almost always extend down well over the thighs. Even here, however, consistency is not maintained, and the relatively small number of surviving Hellenistic images precludes being able to cite this as a definitive observation. While the extreme version in which the *pteruges* end so high as to expose the genitals are rare overall and can probably be considered atypical or unrealistic depictions in which cultural and/or aesthetic considerations have taken precedence over reality, it is not so easy to dismiss the overwhelming body of visual evidence which shows the lower edge of the armor ending no lower than the navel.

Ultimately, this appears to be a case in which practicality and the main purpose of the armor (to provide protection) are in direct conflict with much of the surviving evidence. In our earliest reconstructions, we made our linothorakes as long as possible in order to give the maximum degree of protection without impeding the ability to bend forward easily and pick an object off the ground. For the later ones, we adhered more closely to the lengths observed in the visual evidence. In terms of wearability, there was little difference among them. As far as which variant is more historically accurate, the fairest conclusion is probably to say that it really depends on whether you place a greater weight on practicality or on a literal reading of the images. In either case, it is an argument over just a few inches one way or the other.

There is one specific situation in which we believe a shorter length for the linothorax would have been useful. This is when the wearer was a cavalryman or someone who would have spent a considerable amount of time on horseback. That Type IV armor was worn by ancient cavalrymen is indisputably attested by at least 42 different iconographic images found on vase paintings and in both stone and metal sculptures, including several figures on the famous Parthenon frieze (see figs. 4.6, 7.2).[18]

While we have worn our linothorakes for up to 9 hours at a time in a variety of physical situations ranging from running to sitting and found them to be practical and comfortable, we have not yet attempted to wear them on horseback. On the basis of previous riding experience, however, we suspect that, owing to the extra and repetitive up-and-down motion of being on horseback, shortening the linothorax by a couple of inches would have made riding while wearing one a much more comfortable experience. Therefore, linothorakes intended for cavalry were almost certainly slightly shorter on average than those worn by foot soldiers but still not as short as the extreme examples that fail to cover the warriors' genitals.

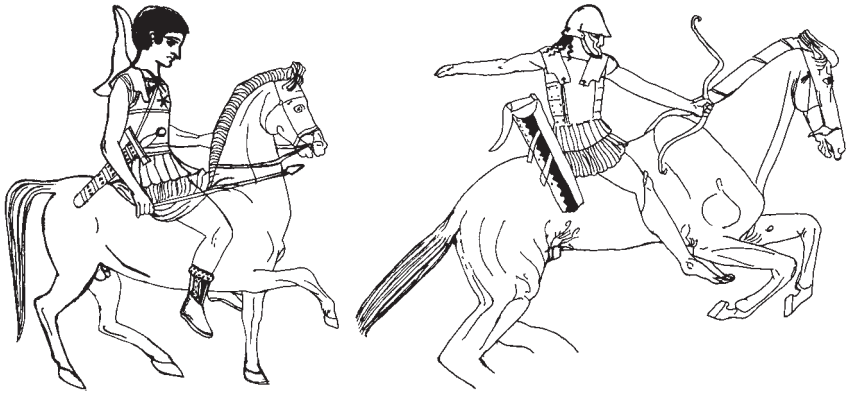

Fig. 4.6. Greek cavalrymen on red-figure vases. For riders of horses, a shorter corselet would have been practical. (*Left*, R-232; *right*, R-159)

Decoration

The last stages of our reconstruction mostly involved ornamental features. Most visual images show the two ends of the main body piece being joined on the left-hand side. Locating the weakest section here would be logical because this joint would be hidden by the wearer's shield and thus be least vulnerable to attack. There are images that show variants on this arrangement, however, including examples where the ends are joined on the right side or even, apparently, at the front, although this would not seem to offer the best protection. Exactly how the two ends were fastened is not clear. Some illustrations appear to suggest that metal disks were sometimes employed, around which cords could be tied or looped. Others seem to indicate a row of holes through which laces were passed. Similarly, the two arms of the *epomides* appear to have been fastened down using leather cords or ropes that were attached to the shoulder arms by being tied through holes in the ends of the arms or onto metal rings fastened to the arms. The other ends of the cords were tied to some form of attachment point (or points). On the chest, these seem to have been either metal rings fastened to the torso or metal disks around which the cords were wrapped.

For our first reconstruction, we pierced holes into the two ends of the main body so that, once it had been wrapped around the torso, the ends were on the left side and leather laces could be passed through these holes to secure the two ends together. Some images suggest that the two ends overlapped, and we accordingly designed the ends of our main body piece to overlap slightly on the wearer's left side

underneath the arm. This extra material also helps in cases where the armor needs to be tightened or loosened to fit the body size of a particular individual. We attached a metal ring to the end of each of the arms of the shoulder section and fastened matching metal rings to the chest of the main body, through which leather laces are looped in order to tie down the arms of the shoulder piece onto the chest.[19] In later reconstructions, we tried other variations for the side attachments—for example, affixing metal rings to fabric straps that were tacked and glued onto the two ends of the torso section. Laces or rope could then be passed through these rings and tied together. This method had the advantage of not having to pierce holes through the tough layers of the torso section. Either method seemed to produce satisfactory and equally functional results.

To our first reconstruction, we added a belt made of thick fabric to be worn at the level of the waist (see plate 6). Such a belt appears in some images, and, although structurally unnecessary, it contributes an extra level of security by holding the main body together if the leather ties break. That these belts are separate items and not painted decorations is made clear on one vase that shows a warrior in the process of wrapping the belt around his waist and preparing to tie the two ends together (fig. 2.6, right).[20] The majority of images do not depict such a belt, however, and in later reconstructions we omitted it.

In our first reconstruction, for the two outermost layers of linen, we used bleached fabric, which gave the final product an attractive finish. The final step in construction was to add decorative elements using paint. While most examples of Type IV armor in art seem to have been fairly plain, many had some sort of adornment in the form of painted patterns, designs, or colors. First, we painted a dark red border around the entire edge of the shoulder piece. Then we painted horizontal stripes of the same color close to the ends of each *pteruge*. Lastly, we decorated the belt with a meander (or Greek key) pattern in the same red color (see plate 6).

In some later reconstructions, we left the linen its natural color, while adding other typical decorative elements, such as a Gorgon head modeled after the one on the Alexander Mosaic and multipoint stars on the *epomides*. In general, for each reconstruction, we added at least a few of the typical design elements observed in the visual images of Type IV armor (see plate 1).

Thickness

An unresolved issue was how thick the linothorax should be, a characteristic determined by two factors: the number of layers of fabric used and the thickness of each one. We made both light and heavy versions, with between 11 and 18 layers of

fabric, producing an overall thickness of 6–14 mm. After experimentation, we settled on a standard for the armor of just over 1 cm in thickness. This was based primarily on the observation that this seemed to be the maximum practical thickness that still retained a full degree of flexibility. There is not any theoretical limitation on thicker armor, but we found that when the thickness was more than a centimeter, it began to be much more difficult to readily bend the laminated sheets into curved forms. Not only was considerable physical strength required, but, more importantly, at thicknesses of more than 15 mm, we began to experience problems with the laminated layers cracking or even delaminating when bent. This suggests a natural limit on laminated armor of around 15 mm in thickness, at least if one wants to be able to bend it. At 10–12 mm, however, a flat slab can easily be bent back on itself into a C shape without any apparent stress damage. At this thickness, the samples also appear to retain their flexibility over time—in other words, the samples can be bent from a flat to a curved shape repeatedly without breaking or delaminating. The oldest of our samples, although over 5 years old at the time of writing, have not yet displayed any signs of coming apart; therefore, at least up to this thickness, the laminated linen technology appears to be stable. The vase paintings seem to indicate relatively thin armor, consistent with our notional thickness of around 1 cm.

One additional finding that emerged from our experiments was that the total thickness of the laminated slab was a much more important factor than the number of layers when it came to determining the point at which it could no longer easily be bent or when problems with stress arose. Some of our 1-cm sections were composed of 19 layers of very thin linen, while others achieved this same thickness using only 10 layers of much thicker linen. In both cases, however, when it came to flexibility and resistance to stress, the performances of the 1-cm-thick 19-layer and 10-layer pieces were, for all practical purposes, identical.

Arrow Test Methodology and Materials

Our reconstructions had established that it was possible to make armor consistent in appearance with Type IV armor using laminated linen. Additionally, we now had a good sense of the shape and some of the characteristics of this armor. The next challenge was to address a criticism leveled against such armor—that it could not have offered effective protection to its wearer—and thus, even if it existed, it must have been regarded as considerably inferior to other types of armor.

Arrow Test Rationale

In assessing how effective the linothorax would have been in this regard, it is first useful to consider what kinds of weapons it was intended to safeguard its wearer against. The most dangerous threat was direct, aimed attacks by heavy, thrusting weapons, chiefly spears and swords. A secondary danger was posed by randomly directed missile weapons, especially arrows, javelins, and shot from slings. Let us consider the hazards faced by some of the different types of troops who seem to have used the linothorax.

One of these was the standard Greek hoplite of the seventh through the fifth century B.C.[1] In traditional hoplite warfare, the principal defense was the large, round shield, or *aspis*, carried by members of the phalanx. This was a heavy construct: a concave bowl 1 m in diameter made of a thick core of hardwood with additional bronze elements, it weighed an estimated 6–9 kg. When carried by ranks of soldiers arrayed in rows, they presented a nearly impenetrable obstacle to attack. There is no doubt that, in this style of warfare, the shield was the primary line of defense, and the hoplite was in theory supposed to use it to block all dangerous incoming sword or spear thrusts. Thus, the anticipated direction of spear and sword thrusts was from the front, where the main defense was provided by the shield. If a hoplite was attacked from the side or back, then the phalanx had failed, and the battle had probably already been lost. The shield could also provide effective protection from missile weapons, but these were more unpredictable and could come at the hoplite from a greater variety of angles. In battle situations, the majority of

arrows and javelins were probably not aimed in a flat trajectory at a specific individual, but rather were lofted so that they would descend from an angle into masses of men grouped together, such as the enemy's phalanx.[2] If hoplites in a phalanx were actively fighting their counterparts, they could not have risked lifting up their shields to fend off incoming missiles from above, and so would have had to rely on their body armor to protect them from this secondary threat. Thus, for hoplites, one of the primary purposes of body armor was to safeguard its wearer against missile fire, with a secondary (but still important) function of offering backup security against spear and sword thrusts that managed to get past the shield.

Another type of fighter was the skirmisher or light infantryman.[3] Labeled with a variety of terms (e.g., *psiloi, peltastai, gymnetes*) and found across the Mediterranean, they would have been armed with a wide assortment of weapons, but a common characteristic was their lack of heavy shields. These troops were not intended to engage in direct hand-to-hand combat with hoplites but to use their agility and ranged weapons to harass and, under the right circumstances, to kill their more heavily armed and armored foes.[4] With such fighters, the main consideration is mobility; thus they would always have been caught in the dilemma of having to choose armor that offered the best possible protection, yet did not significantly impede their speed and agility.

A more interesting case is posed by the heavy Macedonian phalanx, as instituted by Philip II and further developed by Alexander.[5] These soldiers were equipped with the *sarissa*, an extra-long 12–15 ft. spear, in contrast to the 7–9 ft. spear of the hoplite.[6] Given the weight and awkwardness of such a massive offensive weapon, which required both hands to wield, it is not surprising that they carried not the large *aspis* shield but instead a much smaller, lighter version, either suspended from a neck strap or strapped to the upper left arm. For these men, their offensive weapon had effectively also become their primary means of defense. The long *sarissa* was intended to keep opponents armed with thrusting spears or swords at bay, and therefore well out of striking range. If a spear- or sword-armed opponent actually managed to get within range to use his weapon, then the entire premise of the *sarissa*-armed phalanx had already failed. Therefore, to an even more pronounced degree than in the case of the traditional hoplite, a primary function of the body armor of the soldier in the Macedonian phalanx was to counter the threats that the *sarissa* was not meant to stop: arrows, javelins, sling bullets, and other missile weapons that could be fired from beyond the reach of the *sarissas*' spearpoints.

Ancient body armor, including that worn by members of the Greek and Macedonian phalanxes, was certainly intended to provide general protection against a variety of threats. While the preceding discussion has been intended to establish

the specific point that one of these hazards was missile weapons, certain features of Type IV armor, such as the distinctive neck tabs, were obviously designed to counter assaults with weapons wielded by hand, such as swords or axes. Good all-around armor offers protection from an array of hazards, and this was certainly the case with Type IV corselets.

Test Patches

After establishing that at least one of the principal functions of the linothorax was to protect its wearer from attack by missile weapons, we decided to focus on how well it resisted penetration by the most common (and perhaps deadly) of these threats—arrows. This had the added attraction that it is a type of attack that we could precisely regulate and measure, and thus produce scientifically valid test data.

To do this, we constructed several dozen test patches in the form of squares of laminated fabric measuring roughly 2 ft. per side. Testing, which consisted of shooting these patches with arrows under controlled conditions, was then carried out in order to examine the effects of a number of variables. These fell into two basic categories: differences in the composition of the test patches and differences in how we shot them. These included different thicknesses of test patch (ranging from about 4–15 mm in thickness); different numbers of layers of fabric (we used patches of 10, 15, and 20 layers); different types of linen, made by both modern and traditional methods (we also used linens with varying thread counts and thicknesses of individual threads); different glues (both modern and ancient); and changing the orientations of the fabric layers within test patches so as to alternate the direction of the weave from one layer to the next. In the hope of further illuminating the debate as to whether Type IV armor was laminated, sewn, or quilted, we also fabricated three sewn, unstuffed patches and one quilted patch stuffed with raw wool in order to compare their performance with that of the laminated ones. We even fashioned some hybrid patches that were a combination of both laminated and sewn layers. Variables included shooting at each patch from different distances (mostly between 7.5 and 30 m), using different strengths of bows (measured by pull weight), and employing different arrowheads (primarily ones that attempted to emulate ancient arrowheads in material and form, but also a few modern ones).

In order for these tests to be valid, we felt it was important that at least some of them be conducted using the types of materials that would have been available in the ancient world. Obtaining linen that was truly unprocessed and unbleached turned out to be more of a challenge than we had anticipated. Many linens advertised as handwoven turned out to have been processed and harvested by mechanical

means that altered such factors as the presence of natural plant waxes and the tensile strength of individual fibers. We were eventually able to contact groups of women who actually grew and harvested their own flax plants by traditional methods and then processed them by hand. The resulting fibers were spun into thread by hand by the same women, and this thread was woven by them by hand into fabric.[7] We also used the previously described rabbit and flax seed glues in conjunction with the authentic linen patches.

Arrows and Bows

We ordered handmade wooden arrows with natural feather fletching. These ashwood arrows with goose-feather fletching hand-bound to the shaft were 29 in. long with shafts ⅜ of an inch in diameter and weighing approximately 34g. We obtained arrowheads of different shapes made from both hand-forged iron and hand-cast bronze. The arrowheads of each type of metal were then individually finished and sharpened by hand. Modern steel arrowheads, which can take and hold an extremely sharp edge, would have yielded hopelessly unrealistic results, but we employed a few of these for comparative purposes.

We tried to use arrowheads with shapes and weights similar to those of attested examples of ancient Greek, Macedonian, and Persian arrowheads. Our bronze arrowheads, in particular, were selected to be as close as possible in weight and shape to common Greek and Persian arrowheads, such as those on display in the National Archaeological Museum in Athens. The most detailed information about the types and characteristics of ancient arrowheads employed by the Greeks and their enemies can be found in Erdmann's (1973) lengthy article on ancient arrowheads, especially those from the Battle of Marathon. Another useful discussion of ancient arrows is the unpublished Ph.D. thesis "The Effectiveness of Greek Armor against Arrows in the Persian War" by P. H. Blyth (1977).[8] These works offer illustrations and typologies of ancient arrowheads, from which basic shapes can be deduced, as well as overall measurements, but they do not include precise weights. In Erdmann's typology of arrows, the basic categories are: Type A—tanged with rectangular cross sections; Type B—tanged with rhomboid cross sections; Type C—socketed with triple vanes; and Type D—socketed with leaf shape. Blyth adds one more, Type E—tanged and leaf-shaped.

On the basis of these studies, it is obvious that Greek and Persian military arrowheads seem to have come in a wide variety of shapes and sizes, and we selected our replica arrowheads in order to encompass a similarly broad range in terms of weight and shape while still being representative of the more common finds.[9] We

experimented with more than two dozen different replica arrowheads in total, but the seven main ones (fig. 5.1) that we used in our formally measured tests were:

1. A small, iron, tanged, narrow leaf-shaped arrowhead measuring 45 mm (length) by 12 mm (width), with a weight of 13 g
2. A very large, iron, socketed, broad leaf-shaped arrowhead measuring 65 mm by 30 mm, with a weight of 33 g
3. A large, iron, socketed, triangular, barbed arrowhead measuring 50 mm by 37 mm, with a weight of 21 g
4. A medium-sized, bronze, tanged, leaf-shaped arrowhead measuring 47 mm by 18 mm, with a weight of 21 g
5. A small, bronze, tanged, narrow-bladed arrowhead measuring 50 mm by 12 mm, with a weight of 13 g
6. A small, bronze, tanged, barbed arrowhead measuring 27 mm by 17 mm, with a weight of 10 g
7. A large, bronze, socketed, leaf-shaped arrowhead measuring 50 mm by 20 mm, with a weight of 29 g

These seven sizes and shapes are similar to some of the common arrowhead finds from Greece, Asia Minor, and the Near East. The arrowhead types that

Fig. 5.1. Examples of the seven types of replica arrowheads that we used most extensively in our testing. #1, 2, and 3 are iron, and the rest are bronze.

Erdmann cataloged and classified were found at the sites of the battles of Marathon and Thermopylae, in deposits in the Athenian Agora and Acropolis, at the sanctuaries of Olympia and Delphi, and at a scattering of locations in Asia Minor and the Near East. Her study includes some 132 arrowheads supposedly retrieved from battlefields and another 170 from other sites that are now in museums. Although such assumptions are often made, it is not entirely clear from the archaeological evidence whether the arrowheads found at places such as battlefields or sanctuaries represent Greek or Persian designs. Given the wide variety of shapes attested at almost all of these locations as well as at other sites, it seems likely that there were no absolute rules in terms of standardized national designs, and ancient archers likely employed as broad a variety of arrowheads as were available.

Without exact information about weights and metallurgical composition, we cannot state that our replicas precisely imitate the ancient arrowheads that have been found at sites such as Marathon, but in terms of basic characteristics, our arrowhead #1 is the same approximate size and shape as Erdmann's Type A1 and A2. Our #2 and #3 share similarities of size and form with her B1, B2, and B3 Types. Our #4 is close to her Types DI1 and DI2. Our #5 resembles her Type DIIa1, and our #6 is like her DIIb1 and DIIb2.

After all of our planned rounds of testing were completed, we had the opportunity to acquire some additional bronze arrowheads (among these was our #7) that approximated Erdmann's Type CI. This was significant because this is the type of arrowhead that was most commonly found at Marathon. We also obtained several new arrowhead types that were similar to Blyth's added category of Type E (see Blyth 1977, 206). We were not able to run the full array of test shots with these new and particularly "authentic" arrowheads, but we did measure enough shots using them to determine that their performance was within the parameters of the arrowheads with which we did more extensive testing. Therefore, although these arrowhead types do not formally appear in the tables of data, it seems safe to say that we tested them enough to determine that they would not change any of the basic conclusions of this study.

The given dimensions of our replica arrowheads just refer to the molded point sections and do not include the socket or tang portions of the arrowhead. The weights supplied are for the total weight of the arrowhead, including the socket or tang. Arrowhead weights are usually expressed in terms of grains. In this system, the weights of these arrowheads are: #1, 200 grains; #2, 508 grains; #3, 323 grains; #4, 323 grains; #5, 200 grains; #6, 154 grains; #7, 431 grains. By modern standards, arrowheads #2, 3, 4, and 7 would be considered exceptionally heavy, because current standard arrowheads usually do not weigh more than 150 grains. Most ancient

arrowheads also seem to have been lighter, but such heavy weights do appear to reflect the size of at least some of the attested arrowheads used in the ancient world and would have given armor-piercing force to the arrows to which they were attached. Finally, for purposes of comparison, we also tested wooden arrows tipped with modern field points, which are used for target shooting, as well as some aluminum and carbon composite shafted arrows equipped with modern steel hunting points featuring razor-sharp, hardened edges.

Although we wanted to use replica arrows that would emulate the flight characteristics of ancient arrows as much as possible, when it came to a choice of bow, we selected modern compound bows that employ a system of cables and pulleys to bend the limbs of the bow and obtain a specific hold weight at maximum draw. This modern equipment was essential in order to maintain consistency from shot to shot in terms of the power applied to the arrow. If we had chosen replica wooden or composite bows, then each shot would have varied in power because of minor variations in draw length, different archers having different pull lengths, and even the atmospheric conditions at specific test sessions (such as humidity affecting the resistance of the wood or other natural bow materials).

One important issue for which the available ancient evidence is not clear concerns the strength and range of ancient bows. Because the textual and visual evidence seems to suggest that the linothorax enjoyed widest popularity in the period from roughly 650 to 200 B.C., we concentrated on determining what strength bows would have been most commonly used on the battlefield during this time frame. Additionally, we focused particularly on the battles between and among the Greeks, Macedonians, and Persians. With regard to the range and power of bows, the ancient textual evidence unfortunately offers often-conflicting information. As usual, the sources have a tendency to report the exceptional rather than the typical. Thus, for example, in terms of distance, an inscription from around 300 B.C. records a prize-winning archery shot by one Anaxagoras that supposedly traveled a distance of around 500 m (L. Moretti 1953, no. 32); or, concerning power, an anecdote in Xenophon mentions an arrow that had the force to plunge clean through both a soldier's shield and his corselet (*Anabasis* 4.1.18).[10] Further complicating matters, the Greeks, Macedonians, and Persians used a variety of different types of bows during this period, including simple straight self bows consisting of a piece of wood bent and strung; wooden recurve bows in which the wood is molded by heat and force to a shape so that, when strung, the tips of the bow curve away from the archer, thus storing more energy; and composite bows, which are made from various materials (such as wood, horn, and sinew) laminated together, and which can be either straight or recurve.[11]

Ancient testimony, mathematical calculations, and modern experimentation all suggest that an absolute maximum range for ancient bows and arrows used in war during this period would have been around 250 m. At this range, however, the arrows would have been a danger only if they struck exposed skin. A more realistic maximum range for archery probably began around 150 m, but accurate shots that would have had enough force potentially to penetrate light armor were probably not possible at ranges exceeding 50 m.[12] Krentz (2010, 27), using Blyth's data, summarizes the dramatic drop-off in terms of the penetrating power of Persian arrows as range increases. He estimates that war arrows fired from Persian-style bows would have had about 30 Joules of energy at 55 yd., dropping to 26 J at 110 yd., and 20 J at 220 yd. The numbers for Scythian bows are: 20 J at 55 yd., 15 J at 110, and only 9 J at 220. As our test results will show, using these figures, none of these arrows would have penetrated one of our standard 10-mm-thick laminated linen test patches. Most effective archery against soldiers with any sort of armor likely had to take place at distances well under 50 m.[13]

Given the uncertainties as to the exact powers and ranges of the bows used by ancient Greeks, Macedonians, Persians, and their foes, as well as the great diversity of types of bows that were used by these groups, we decided to employ several bows that would represent different strengths so as to cover a range of possibilities. Today, the power of bows is usually expressed in terms of the draw weight.[14] For our tests, we had the hold weight at maximum draw of our modern compound bows measured, and this gave us a precise figure that would not vary from shot to shot. We mainly used three different bows, calibrated with hold weights of 25, 45, and 60 lb.[15] The energy of most of the arrows (calculated in the first 15 m of their flight) that we shot from these three bows varied from roughly 35 to 80 J. In terms of the energy applied to the arrow, our 45-lb. bow was probably the closest to the "typical" war bow of a Greek or Persian archer. We also took shots with a replica traditional longbow made of ash wood with an approximate draw weight of 50 lb. While we did not include these data in our formal results because of the inconsistency issues already noted, the performance of this bow was nearly identical to that of the 45-lb. draw weight compound bow.

Arrow Test Procedure

The flat fabric test panels were affixed to a standard foam archery target block. The density of the block roughly emulates the resistance encountered in the soft portions of a human (or animal) target, and therefore, with the armor patch secured to

its surface, the foam block crudely simulated an arrow striking a human being wearing armor of the given type. This target block was securely strapped onto a heavy wooden stand, ensuring that the full force of the arrow impact was transmitted to the test panels and was not at all dissipated via movement of the entire foam block (fig. 5.2).

Ideally, we would have used ballistic gel for the backing rather than the foam block, but this was beyond the budget of our project. Ballistics gel is a substance used by the military and law enforcement in estimating the depth of penetration of bullets and stabbing weapons into a human body. However, after all of our principal testing had been completed, the Discovery Channel filmed a short piece on

Fig. 5.2. Test stand. The square linen test patch is attached to an archery foam block, which is itself firmly strapped to a heavy wooden test stand.

our project for which it provided a ballistics gel dummy (plate 7). While we were not able to run a complete sequence of test shots using this dummy, we did shoot it with a representative sampling of arrowheads from all three of our main bows. The results of these tests suggest that the foam block that we used actually had properties of resistance remarkably similar to ballistics gel. For example, when the gel dummy was shot from a range of 7.5 m with the 25-lb. bow and a bronze medium-sized, leaf-shaped arrowhead, the arrow penetrated 192 mm into the gel. When the foam block was shot with the same bow and arrowhead at the same range, the arrow penetrated 180 mm into the foam.

So that we could compare the performance of different test patches, every shot was numbered, and for each shot, we recorded the shot number, the distance to target, the bow strength, the type of arrowhead, and the angle of the archer in relation to the target. The vast majority of our test shots were fired from a position in which the archer was exactly perpendicular (90 deg.) to the flat face of the target.

The effectiveness of the shot was evaluated by measuring the depth to which the arrowhead penetrated past the surface of the test sample patch. For shots that passed completely through the test patch, the total depth of penetration included the thickness of the test patch plus the distance that the arrowhead bored into the foam block. The holes in the test patch were marked with the number of each shot so that, knowing the relevant information about distance, bow strength, and other variables, we could later examine the holes in detail (fig. 5.3). We took multiple shots at each permutation of test patch, distance, bow strength, arrowhead, and angle, and then averaged the depth-of-penetration results to come up with the final average penetration figures that appear in our tables, and which were used to compare the performances of each test patch.

We chose depth of penetration as our standard measure of performance in these tests, because it was the easiest way to express our results in an instantly comprehensible manner. A specific test patch would either keep one safe or not, and the depth-of-penetration number would immediately and vividly convey this basic information. One problem with this methodology, however, is that it is difficult to compare our results to those of other similar experiments because the depth-of-penetration figures are dependent upon so many variables specific to the equipment that we used, such as the test patches, arrows, and arrowheads.[16] We therefore selected an alternative form of data with which to express our results that would be more universally applicable and would incorporate all the variables. Each shot can also be measured in terms of the kinetic energy expended when the arrow strikes the target patch. By noting shots that just managed to penetrate a given test patch

Fig. 5.3. Preparing to measure arrow penetration into a test patch. Every shot was numbered and labeled on the test patch, and the relevant information about distance, angle, arrowhead, patch, and bow strength was recorded.

to a potentially fatal depth, we can determine the amount of energy needed to defeat the patch. For these calculations, energy is expressed in terms of Joules in the formula: energy (J) = ½ mass (kg) multiplied by the velocity (m/sec) squared, or $E = \frac{1}{2} \times M \times V^2$.

For these calculations, the mass for a given shot could easily be obtained by adding the weight of the arrow plus the weight of the arrowhead, but we needed to ascertain the velocity of the arrow at the moment of impact. After release from the bow, arrows require a certain distance to stabilize their flight, after which they follow a predictable path in terms of loss of velocity per distance traveled.[17] The majority of our test shots were taken at close ranges of 7.5 and 15 m, at which distance, after stabilization, there was not much loss of velocity over the course of the arrow's flight due to factors such as drag.

We used three methods to measure velocity:

1. We measured the velocity of the arrow during just the last 5 m of its flight, representing its speed just before impact. We did this by placing a 5-m bar marked at 10-cm intervals with black and white patches perpendicular to the test patch and then mounting a camera so that it filmed the flight of the arrows as they traversed the bar. By viewing the resulting time-stamped film frame by frame, we could measure the amount of time the arrow took to traverse this distance and thus obtain a velocity figure for the terminal segment of the arrow's flight.
2. We filmed the entire flight of an arrow from the time of its release from the bow to its impact with the target over 7.5-m and 15-m distances. Again, analyzing this film frame by frame, we could use the time stamp to calculate the average velocity of the arrow over its entire flight.
3. We used a commercially available archery radar gun to measure the velocity of the arrow in flight when shot at 7.5-m and 15-m distances.

While there was some variation in the velocity figures obtained by these three methods, because of the relatively short distances involved, they all yielded fairly consistent results. For example, the range of velocity figures for a wooden arrow with a field tip shot at least three times using each of the three methods was 37–42 m/sec with the 25-lb. bow, 47–54 m/sec with the 45-lb. bow, and 58–62 m/sec with the 60-lb. bow. Thus, even in the worst case, the margin of variation in measured velocity was less than 13%, and the majority of shots clustered within a much narrower range for each type of bow.

Arrow Test Results

By the end of our arrow tests, we had taken more than 1,100 shots, for each of which we measured and recorded between 7 and 11 variables. Once we had analyzed this body of data, clear trends emerged that allowed us to determine which factors made a significant difference to a test patch's resistance to penetration. We were also able to evaluate some of the possibilities for how the linothorax was constructed, including sewn, quilted, and laminated variants, and even how linen compared to bronze. Most importantly, we proved that the linothorax was a viable form of armor.

General Observations

The arrow tests revealed that the laminated linen armor was surprisingly resistant to arrow attack. For example, when a 20-layer laminated test patch of 11.5-mm thickness was shot from 15 m with a 45-lb. pull bow with any replica point (an energy range of 55–70 J), the arrowhead failed to fully penetrate the test patch. To give an idea of the degree of protection afforded by the linothorax, when the medium-sized, bronze, leaf-shaped arrowhead was shot at the foam target block without any test patch affixed to it from a weak 25-lb. bow at a range of 7.5 m (41.5 J), the arrow still had enough power to penetrate an impressive 231 mm deep into the foam target block.[1] This would be analogous to shooting at an unarmored person, and in the ancient world, if an arrow went even a quarter of this distance into a person's torso, it would almost always have resulted in a fatal hit, if not from immediate trauma, then from subsequent infection of the thoracic or abdominal cavities. When the same arrow was shot under the same conditions at the foam block with the 20-layer laminated test patch attached, however, it penetrated a mere 12 mm into the test patch, failing to perforate the armor and leaving the foam block (or hypothetical person) completely unscathed. The minimum kinetic energy required to penetrate our most historically accurate patch (a 12.25-mm thick patch made using rabbit glue and "authentic" linen fabric) to a potentially fatal depth was about 70 J.[2]

Numerical depth of penetration data for the main arrowheads, test patches, bow strengths, and distances that we experimented with can be found in tables 1–20 at the end of this chapter. The depth-of-penetration measurements given in these

tables represent averages from multiple shots taken under the same set of variables. Those interested in the raw numbers can consult these tables, while most of the remainder of this chapter offers a narrative analysis of the conclusions that we reached on the basis of this experimental data.

When the results of the arrow tests were fully analyzed, some basic conclusions emerged. Doubling the thickness of the target patch roughly doubled the patch's ability to resist penetration. Overall, the thickness of the test patch proved to be the single most significant variable. Both the shape and the weight of the arrowhead substantially affected the penetrative power of the arrow. The most important general conclusion was that a roughly 1-cm-thick linothorax could have protected an ancient warrior from fatal arrow hits from the types of bows and at the sorts of ranges most likely to have been encountered (shots of up to at least 70 J force). A shot from an unusually powerful bow at point-blank range of less than 10 m might have penetrated, but such shots would have been much rarer.[3]

Varying the distance to the target had some effect, but not as much as changes in the thickness of the patch, the power of the bow, or the type of arrowhead. While this might sound surprising, most of our tests were conducted at relatively close ranges of between 7.5 and 30 m (fig. 6.1). In battlefield terms, any of these distances would effectively have been considered very close range. Because of the short distances involved and the high velocity of the arrows, the trajectory of the arrows in all of these shots was nearly flat. Such close-range shooting would have occurred in some siege situations or in the very last seconds of a charge.

We also took shots at the patches from longer ranges, in which the arrows were fired at an upward angle of 20–45 deg. so that they arced down onto the target along a curved trajectory. This is probably more similar to the sort of archery that would have constituted the majority of shots fired on the ancient battlefield. When fired in this manner, none of the arrows fully penetrated the test patches. Some of them partially penetrated and stuck into the test patches, but just over half bounced off, leaving only an indentation in the surface of the test slab. This result strongly suggests that the linothorax would have offered excellent protection to its wearer from these sorts of randomly falling arrows. Because all of the patches resisted penetration at long distances no matter what bow or arrowhead was used, we were unable to distinguish in any meaningful way the effect of variations among the patches in terms of how they were constructed; therefore, we concentrated on the short-range tests, where we could measure significant differences in how patches of diverse types performed.

Lest anyone harbor doubts that our test methodology using test patches mounted on a foam block did not realistically simulate the effect of an arrow striking a

Fig. 6.1. Shooting at test patch from 30 m away. Most of our shots were from this distance or closer. At ranges longer than this, the arrows had to be fired in increasingly higher-angled arcs, and nearly all of these shots failed to penetrate the armor.

linothorax being worn by a person, it should be noted that on two occasions toward the end of our sequence of tests, one of us (Bartell) donned a 10-mm thick linothorax and was repeatedly shot in the chest at close ranges (about 3–5 m) with a variety of arrows fired from a bow by the other (G. Aldrete). The performance of the armor in this "real life" situation was identical to that exhibited by the test patches (plate 8).[4] The arrows fired with weaker pull weights tended to bounce off the armor, while those fired at higher power stuck rather dramatically into the armor. Many of these were firmly affixed, and because we found that having a 30-in. arrow protruding from one's armor was an impediment to arm movement, this experience suggests that an ancient warrior thus struck would have had to at least pause to yank the arrows free before he could resume fighting at full efficiency. One thing that the live test allowed us to assess, which shots against the foam target did not, was to what degree the physical force produced by being struck by

an arrow, even when it did not penetrate, might jolt or even cause injury to a warrior wearing this type of armor. While the impact of the arrow to the chest produced a force equivalent (at most) perhaps to being slapped, it did not cause any bruising or impair the victim in any way.

In the interests of safety, it should be noted that these "live target" shots were attempted only after we had made more than 500 shots at the test patches, so that we were able to predict precisely how far the arrow would penetrate. Additionally, the test subject wore a metal Corinthian style helmet to protect his head, and one of the test patches was placed underneath the armor just in case an arrow somehow penetrated. We vigorously discourage others from attempting any such shots without at least equivalent experience with the materials involved and without having taken similar precautions.

Less Significant Test Variables

A surprising result of the tests was that several variables we anticipated would play an important role affecting the protective ability of the armor turned out to have little or no effect. One such factor was alternating the direction of the weave of the fabric from one layer to the next. Before the tests, we had speculated that a test patch constructed so that the weave of its fabric went in the same direction in all of its layers would not offer as good protection as one that was constructed so that the direction of weave in alternate layers ran at 90-deg. angles to one another. It seemed logical to assume that a penetrating point would have an easier time cutting through a slab whose layers' direction of weave was parallel than one in which every layer's direction of weave ran at right angles to the one above it. In addition, we constructed a test patch in which, for each layer, we rotated the direction of weave 45 deg. from that of the previous layer, in order to see if this slightly more complex arrangement would make a difference in the resistance offered by the patch. When shot with arrows, however, both patches performed nearly identically, both to one another and to the patches whose layers had their weave oriented all in the same direction. There was no perceptible advantage to the patches whose layers changed the direction of the weave.

One explanation for this observation is that, once saturated with glue, the layers effectively form a single composite slab and, in this new form, the direction of weave no longer plays a significant role in comparison to the resistance offered by the slab as a whole. The thinness of the penetrating tips of the arrowheads also means that relatively few threads of fabric are involved at the point of contact, so that their orientation in relation to one another is not that important a factor. A cross-weave

pattern might still offer greater resistance to cutting forces exerted over a large surface area, such as would occur if one sliced at a linothorax with the long edge of a sword. A cross-weave pattern might also help to increase the overall durability of the armor—for example, by reducing its tendency to fray. Thus, while there might still be practical reasons for positioning the layers in a cross-weave pattern, such a design did not have a statistically meaningful effect on a slab's resistance to penetration by arrows.

Another variable that did not seem to make much difference was the number of layers of fabric. We had expected that a patch made of many thin layers of linen would offer greater protection than a patch of the same overall thickness made with fewer layers of thicker linen. Once the layers were bonded together into the laminated slab, however, the only variable that really seemed to matter was the total thickness rather than the number of layers, and the resistance afforded by patches with very different numbers of layers but the same overall thickness was, again, virtually identical. Similarly, the choice of glue did not meaningfully affect the test results. As long as a given glue was sufficiently liquid to saturate the layers during construction and strong enough to bond the layers thoroughly, which glue we used did not seem to have much of an effect. Modern animal and PVA glues and rabbit skin and flax seed glues all met the above requirements, and the variations in performance of test patches made with each were negligible.

Hand-Produced versus Modern Linens

Where "authenticity" did play somewhat of a role in the test results was not in the glues but in the fabric. Our test patches whose fabric we believe best approximated that found in the ancient world—the ones made out of linen that had been grown, processed, spun, and woven entirely by hand—did have different properties than the other samples that we tested. This was true even compared to linen that had been handspun and handwoven, but whose fibers had been obtained from mechanically processed flax plants. As previously described, when still in the stem of the flax plant, the bast fibers are encased within a waxy matrix of pectinous material. While today all traces of this waxy material are entirely removed during processing, we found that our linen made from hand-processed flax still retained a certain waxy quality to its fibers, even when it had been spun and woven into cloth. Initially, this waxiness made the authentic linen somewhat more difficult to laminate because the glue was neither as easily nor as quickly absorbed by the individual fibers. We learned to overcome this by allowing more time for the glue to saturate the first layer before applying the second and by occasionally adding extra glue to the

second layer of fabric. When the glue had dried, small bits of this linen also had a somewhat more brittle quality than our other fabrics. For example, individual threads coated with glue that protruded from the edges of a laminated slab tended to snap off rather than bend, as they did in our other patches. The laminated slab as a whole, however, seemed to retain indefinitely a slightly gumlike consistency not apparent in the slabs made of modern linen.

During the arrow tests, the "historically authentic" linen sample demonstrated different qualities than patches made from fabric processed using modern methods.[5] For example, when we directly compared the performance of a 12-mm-thick slab made from the "authentic" fabric with an 11.5-mm-thick slab made from modern linen, we found that the first few layers of the "authentic" slab were more easily pierced and that a much higher percentage of arrows stuck in the slab. This was especially true of low-power shots, which typically bounced off the harder surface of the patch made from modern materials. When the same low-power shots were directed at the "authentic" patch, the arrowheads tended to penetrate slightly deeper, and the arrows, whatever the depth of penetration, were far more likely to stick in the patch rather than bounce off. As the power of the bow increased, this effect was still evident but appeared to diminish somewhat. At ranges of 30 m or more, the performance of the "authentic" and modern patches seemed similar, although arrows still had a tendency to stick more readily into the "authentic" patch.

We believe these observations can perhaps be explained by the unusual qualities of the "authentic" fabric itself, which, as mentioned, was softer and gummier than the modern samples. This gumminess allowed the low-power shots to penetrate a few millimeters and also caused the fabric to "catch" the arrowheads, so that the arrows stuck in the patch rather than bouncing off it. In contrast, when the modern patches were struck, the harder, stiffer fabric offered more initial resistance. The reduced resistance to penetration offered by the more historically "authentic" fabric was not enormous but was nonetheless statistically significant. The test data suggest that the "authentic" slabs had perhaps 10% less resistance to penetration than a modern slab of equal thickness.

Laminated versus Sewn and Quilted

Another issue that we were eager to test was the resistance to penetration presented by laminated versus sewn and quilted linen. We made several test patches consisting of layers of linen sewn together without any stuffing between the layers. One

of these sewn unstuffed test patches had the layers stitched together only around the edges of the 45-cm square, while in another the stitching joined layers in a crosshatched pattern, creating diamonds approximately 8 cm per side. In the arrow tests, there were no appreciable differences between these two styles of sewn patch. We additionally made one test patch consisting of two layers of linen sewn together and stuffed with raw sheep's wool. This patch had cross-stitching forming quilted squares about 8 cm per side (fig. 6.2).

Out of curiosity, we constructed one 20-layer patch that incorporated both unstuffed, sewn layers and laminated layers. On the outside were 3 laminated layers, after which came 6 sewn layers. The center of the patch consisted of 2 laminated layers followed by 6 more sewn ones and then finished with 3 more laminated layers,

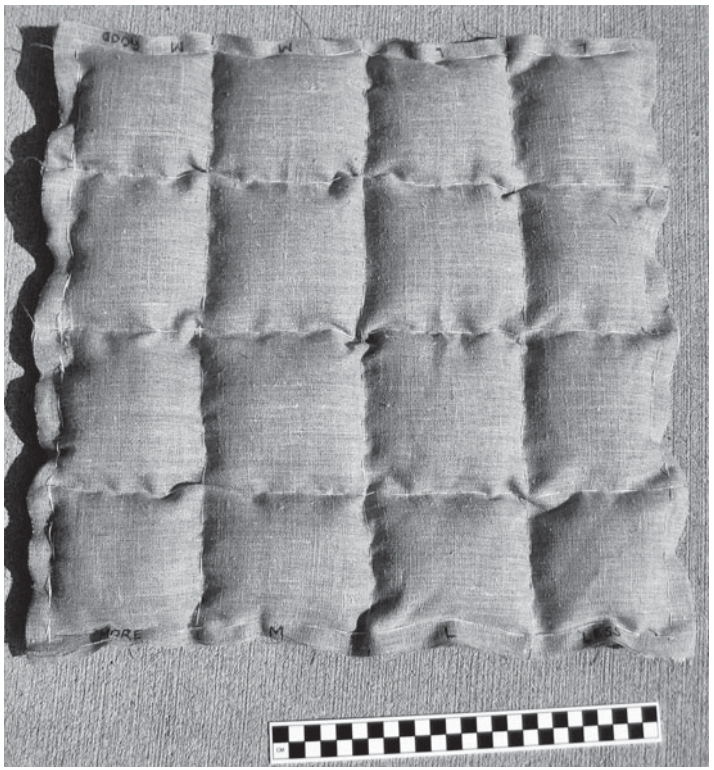

Fig. 6.2. Quilted linen test patch stuffed with densely packed raw sheep's wool. This patch proved to be much more vulnerable to piercing by arrows than multilayered sewn or laminated patches.

for a total of 20 layers (an overall pattern of 3/6/2/6/3). In the arrow tests, the performance of this patch was similar to those of the all-sewn patches.

Overall, the sewn, unstuffed patches offered good protection against arrow penetration. In fact, a higher percentage of arrows fired from low-power bows or at long ranges tended to bounce off the sewn, unstuffed target patch than off the laminated test patches. In these cases, the arrowheads tended to penetrate into the sewn test patch the same distance as into the laminated patches, but whereas the arrows stuck in the laminated patches, they frequently bounced back out of the sewn ones. The explanation for this was that these sewn patches presented a softer, more flexible surface than the relatively rigid laminated patches, and this flexibility served to eject the arrows rather than allowing them to lodge in the fabric.

While the sewn patches were better at repelling weak shots, more high-powered ones had a tendency to penetrate deeper into the sewn patches than the laminated ones. This also does not seem surprising, considering that, with the laminated patches, arrows had to penetrate both the layers of fabric and the glue with which they were saturated, whereas in the sewn patches only the fabric was creating resistance. The differences in performance were not consistent and probably amounted to less than 15%. The soft, sewn patches were particularly vulnerable to much deeper penetration than the laminated patches when arrowheads with long cutting edges were used. Such arrowheads more easily sliced through the soft fabric of the sewn patches, whereas the hardened surface of the laminated patches offered considerably greater resistance. While it has been suggested that sewn armor in the ancient world might have been made from fabric that had undergone additional treatment to harden it or enhance its resistance to penetration, our tests indicate that, at least when many layers of fabric were involved, such treatment might even have been counterproductive.

These tests indicate that the multilayered, unstuffed, sewn technique could well have been a variant mode of construction for Type IV armor, because such armor would have had the advantage of being more flexible than laminated linen armor while still offering nearly the same protection per amount of materials used. This raises the interesting question as to which method of manufacture would have been easier and cheaper. The sewn variant would have required a high level of sewing skills, whereas the lamination procedure could have been done by anyone with the most minimal training. The laminated variant certainly seems easier and quicker to construct. Sewing all of the seams would take far more man (or woman) hours of labor than would gluing. On the other hand,

one could work continuously on a sewn version, whereas the laminated layers would have to be allowed to dry a substantial amount of time between adding layers.

Making test patches using the unstuffed, sewn method raised the practical issue of how to sew one layer to the next. The first two (or even several) layers were not difficult, but then we had to find a way to sew additional layers onto the existing ones. This problem alone might have rendered impractical this procedure for making the armor. We managed to construct one small 15-layer patch in which the needle was passed through all 15 layers to sew them together. This was an arduous process and at times required us to pound on the needle with a hammer-like object. Because we were barely able to penetrate the layers using an extremely sharp, narrow, and hard modern needle, whether it would have been possible to do the same in antiquity with needles that were larger, duller, and less durable is questionable. While perhaps possible, it certainly would not have been easy.

The true quilted, stuffed patch, which consisted of just two layers of fabric with wool crammed tightly between them as stuffing, did not fare well in the tests. It did have a tendency to cause extremely low-power shots to bounce off in a manner similar to the sewn, layered patch. However, most arrowheads, even those shot from the weakest bow, penetrated the stuffed, quilted patch to a much greater degree than any other test patch. The only resistance it offered seemed to derive from the two layers of fabric themselves. The approximately 35 mm of densely packed wool added only negligible additional resistance to penetration. While such a quilted, stuffed garment might have served well in absorbing blunt trauma when worn under a more rigid type of armor, it would have been extremely ineffective in resisting penetration by arrowheads. In fact, the initial test results with this patch were so discouraging—with arrows ripping through it and penetrating deep into the foam backing block almost as easily as when there was no test patch present at all—that we did not bother running the full array of tests on it.

Different Arrowheads

We used seven main types of replica arrowheads (see chapter 5 for details), and it was possible to hone all of these to a fairly sharp edge with a metal file. With use, however, the edges quickly became blunted and required constant resharpening.[6] We did not have access to the equipment necessary to measure the hardness of our bronze and iron replica arrowheads precisely, but we observed that,

in general, the bronze points tended to lose the keenness of their edges more readily. There was a measurable drop-off in penetration by the bronze arrowheads after just a few shots, which was attributable to their edges having been dulled by use. Though holding an edge longer than the bronze arrowheads, the iron ones showed similar dulling after fewer than five shots. For consistency, we attempted to sharpen each arrowhead to the maximum degree that the metal allowed after every other shot.

With a few exceptions, the heavier points tended to have greater penetrative power than lighter ones of the same shape. Because the striking force of the arrow is a measure of the velocity of the arrow multiplied by the mass of the arrow, this result is consistent with expectations.[7] Those arrowheads whose cross-sectional area was smaller, however, tended to penetrate more deeply than those with large cross-sectional areas. Since the greater the cross-sectional area, the greater the resistance, this was also an expected result. The arrowheads that were most successful overall in penetrating the test patches were the long, thin, narrow iron and bronze arrowheads that had the smallest cross-sectional areas and long, sharply angled cutting edges. These points were most similar in shape to other types of arrowheads, such as the famous medieval bodkin point, whose primary purpose was to punch deeply into an armored target. With higher-power bows, the heavier arrowheads that generated greater kinetic energy due to their mass also penetrated deeply. The arrowheads that were least effective in terms of penetration depth were the barbed points, whose widely projecting barbs created more cross-sectional area, and hence more resistance, when cutting through the test patches.

We also shot at the test samples with a few modern arrowheads. One of these was a standard field or target point, which is designed not to penetrate deeply. Because of this quality, which meant that the majority of shots only partially penetrated the patches, this arrowhead was useful in evaluating precise differences among various target patches, and we often employed it as a benchmark by which to judge other arrowheads. For a comparison with modern archery technology, we also shot at the patches with a few modern hunting arrowheads. Whereas the linothorax provided good protection against all of the replica points, the modern broadhead hunting point slashed through it in a dramatic fashion, penetrating deeper than any of the replicas (fig. 6.3). This 125-grain point, made of high-carbon steel, has three razor-sharp blades, and its superior performance vividly illustrates how technological advances can greatly magnify the lethality of a weapon system.

Fig. 6.3. The advantages of modern technology were vividly illustrated when we shot a test patch with a modern razor-sharp, high-carbon steel, hunting broadpoint arrowhead. It ripped through the test patch and penetrated far deeper than our replica ancient arrowheads.

Depth of Penetration and Lethality of Injury

Despite the considerable extent to which our tests favored the archer, the test patches performed impressively. Even under such perfect conditions and at an extremely short range of 7.5 m, the 12-mm-thick authentic patch would probably have saved its wearer from fatal arrow hits delivered by everything except quite powerful bows (at least 60-lb. pull weight). While some of the arrows penetrated at this range, they usually did not go more than 40 mm deeper than the outer surface of the test patch. At a range of 15 m, even a 60-lb. bow shooting the heavy, leaf-shaped arrowhead penetrated, on average, 40 mm past the outer face of the test patch. For reasons that will be explained below, such a hit would have inflicted at most a minor injury on the wearer, but almost certainly would have been neither fatal nor even incapacitating. At 100 m or more away, even the 60-lb. bow failed to produce hits that fully penetrated the test patches.

In assessing whether an arrow hit would have caused serious injury or death, there are four factors that need to be considered: the total depth of penetration of

the tip of the arrowhead past the outer surface of the test patch (the number that we measured); the deformation of the armor itself that occurred as the arrowhead bored through the layers of the test patch; the additional protection offered by clothing worn under the armor; and the depth that an arrow must penetrate into the human body in order to inflict serious injury. If we take as an example the data cited above for an arrow shot at a range of 15 m penetrating 40 mm past the outer face of the armor, it initially sounds as if this arrow would then have penetrated 28 mm into the wearer's body (40-mm total penetration minus 12-mm thickness of the test patch). This, however, would not have been the case.

First of all, when struck by powerful hits, the test patches, because of their flexible nature, distorted inward to a dramatic degree, basically bending before breaking. This produced a deformation of the inner surface of the test patch that was quite substantial, usually measuring about the same as the depth of the test patch. This bending of the slab around the point of impact means that, in order for an arrowhead even to begin to penetrate the body of the wearer, it has to traverse the thickness of the patch *plus* the distance of deformation. Thus, when reading the test results data, a general rule of thumb is that, for a 12-mm-thick test patch, one has to add an additional 9–12 mm before the tip of the arrowhead would even begin to project beyond the back surface of the test patch. For example, if a shot is listed in the data as penetrating 19 mm, this probably means that the tip of the arrowhead did not quite manage to fully penetrate the test patch. Only a shot that had a total penetration depth of more than 22 mm would have resulted in the tip of the arrowhead beginning to protrude through the inner surface of this test patch. Therefore, in order to calculate the extent of penetration beyond the inner surface of the test patch, all the figures need to have 8–12 mm (depending on the depth of the test patch) subtracted from them.

Next, one has to consider the additional protection offered by clothing worn under the armor.[8] Vase paintings consistently show that soldiers wore clothing beneath Type IV armor. If for no other reason, these garments would have served an important practical purpose—protecting the soldier from uncomfortable chafing caused by his skin rubbing against his armor. In art, this layer of clothing is indicated by a dense bunch of folds hanging below the *pteruges* of the armor. Also, scenes of warriors engaged in the process of putting on their armor plainly depict them wearing the standard Greek *chiton*, a long, tunic-like garment reaching to just above the knees. These seem to have been extremely voluminous garments; thus, when constrained by the armor, the extra fabric of the *chiton* bunched up, producing the many folds seen in the paintings (see, e.g., figs. 1.1, left; 8.1). The multiple folds of these garments would have provided several additional layers of

protection that arrowheads would have had to penetrate before inflicting injury on the wearer. Not only would an arrow need to have sufficient force left after puncturing the armor to penetrate through these layers of fabric, but the clothing and the space enclosed within its folds would have added a further distance that the arrowhead would have had to traverse. This distance would typically have amounted to at least 5 mm. Therefore, when considering depth of penetration figures, we now have to add together the 12-mm thickness of the armor itself, the 10-mm deformation distance, and a 5-mm allowance for clothing, for a total of at least 27 mm that the arrow's tip needed to travel before encountering the hypothetical linothorax-wearer's skin.

The final factor to consider is how deeply an arrowhead needs to penetrate into the human body before it causes significant injury. A recent study by Bleetman and Dyer (2000) has determined that, for adult males in a standing posture, a blade would have to penetrate, on average, at least 18 mm into the human body before it would begin to perforate any vital organs (defined in the study as the kidneys, spleen, liver, pericardium, and pleura).[9] This study, which was intended to help establish standards for the stab resistance of modern body armor, used ultrasound to measure the average depth of various organs when the subjects were supine, standing erect, and leaning at a 45-deg. angle. It also considered the position of the body's organs at different stages in the breathing cycle and the degree to which posture affects the exposure of the organs beneath the lower costal margin (how much they were exposed below the level of the ribs). Thus, when interpreting our test data, a potentially fatal hit is defined as one that penetrated a total of at least 45 mm past the outer surface of the test patch (12-mm patch thickness + 10-mm deformation + 5-mm clothing + 18-mm skin and superficial muscle = 45 mm).[10]

Angled Shots

Most of our tests were set up so that the arrow struck exactly perpendicular to the face of the test patch, but we also experimented with shots that struck the patch at a 45-deg. angle. The very highest energy shots penetrated the test patch in a manner similar to a perpendicularly angled test patch. Not surprisingly, however, many of the 45-deg. angle shots had a significantly greater tendency to skip off the angled test patch outright, and those that did stick in it did not penetrate as deeply. Also, when using a 12-mm-thick test patch, the 45-deg. angle gives the armor an effective thickness of 17 mm, because this is the distance that the arrow has to traverse in order to penetrate the patch. This additional distance produced by the shots hitting the test patch at an angle is exactly the reason why sloped

armor has been such a desirable design feature on tanks and armored personnel carriers.

On an ancient battlefield, few arrows would have struck a soldier at an ideal 90-deg. angle, for two main reasons: most arrows would already have been approaching the target at an angle, most likely as they descended in a shallow (or steep) arc; and the majority of the surfaces on Type IV armor are themselves curved. The main section worn around the torso forms a steadily curving tube around the wearer's body, and likewise the shoulder flaps constitute smoothly curving surfaces as they cross up from the wearer's back, over the shoulders, and down across the chest. About the only flat surfaces on the entire suit of armor are a small section in the middle of the chest and a similarly tiny region in the middle of the upper back.

While the advantages of angled armor are well known, in the course of our experimentation we observed an additional beneficial feature that we had not anticipated, when the armor was struck by arrows that hit the test patch at an angle, especially a sharply acute angle. Some of these arrows tended to bend slightly away from their original vector and burrow between two layers of the laminated slab rather than continue to cut deeper into it. It seemed that a layer would sometimes "catch" the tip of the arrow and slightly shift its vector of movement along a path of least resistance between that layer and the next, rather than allowing the arrow to penetrate into a new layer of linen. The practical effect for a hypothetical linothorax wearer would have been that some of the arrows would have been redirected away from his body and would have harmlessly dispersed their energy while burrowing sideways between two layers of fabric. This beneficial effect would have been unique to armor made of laminated layers of fabric. Leather or metal armor made of a single, uniform substance (rather than a series of distinct layers) would not have similarly caught and redirected the arrow points. This "redirecting effect" exerted by the laminated slab when struck at an angle was an unexpected yet completely logical bonus quality that enhanced its protective ability.

Our test conditions represented a worst-case scenario for the armor in which the target is stationary, the orientation of arrow to target is exactly perpendicular, the range is very short, and the target surface itself is flat. On an actual battlefield, each of these factors would have been encountered in other than the ideal form in the tests, and each would have effectively decreased the penetrative potential of the arrow. In our tests, the full force of the arrow's velocity and weight was cleanly transmitted to the point of impact, and none of this energy was lost. As has been explained, however, most real-world arrow strikes against a linothorax would have been at an angle—and often a steep one. Thus, the arrows would have been hitting a curved surface rather than the perfectly flat one of our test panels. Finally,

the person wearing the linothorax might well have been in motion or twisting. Each of these factors would have absorbed or dissipated some of the energy of the arrow, substantially reducing its penetrative power. If the arrow hit at any angle other than perpendicular to the surface of the linothorax, it would also then have had to cut through more material as it followed a diagonal path through the armor, thus effectively increasing its notional thickness. Therefore, the performance of a linothorax in battle would almost certainly have been considerably superior to that of the patches in our ideal (for the archer) test conditions.

Test Results Compared to Ancient Source Testimony

Much of the reason for the impressive performance of the linothorax in these tests has to do with the fundamental nature of the materials used. When an arrow tip strikes a hard surface such as metal, the entire force of the arrow (mass times velocity) is transmitted to the tiny point of impact. When an arrow hits a linothorax, however, the softer surface of the linothorax flexes and bends, so that the force of the arrow is absorbed over the entire surface rather than just at the point of impact. In addition, when an arrow hits a hard, uniform surface, it is in essence cutting through only a single, homogeneous layer. When it hits the linothorax, each layer of fabric offers a separate obstacle that has to be cut through individually. In some ways, with its laminated fabric composition, the linothorax resembles an ancient forerunner of modern Kevlar armor, which similarly employs layers of fabric-like material to absorb the force of impacts and resist penetration.

In terms of testimony in the ancient sources regarding the effectiveness of linen armor, the verdict is ambiguous. In the course of a discussion praising the unusual scale armor of the Sauromatians created from split horses' hooves, Pausanias makes the comparative statement that, in war, such armor is superior to *thorakes* made of linen because linen armor can be penetrated by iron points propelled with great force (1.21.5–7).[11] However, he further notes that linen armor is superior when hunting because it is good at catching and deflecting the teeth of lions and leopards, even causing them to break off. The whole context of this discussion is so esoteric that one hesitates to draw definitive conclusions from it, but nonetheless it is interesting that linen is cited as being vulnerable to direct, extremely forceful thrusts in war but good at "catching" and neutralizing points, such as the teeth of large predators. This comment suggestively recalls the ability of the layers in a linothorax to "catch" and redirect arrows that strike it at an angle. The comparison is further strengthened by the similarity in shape of predatory animals' triangular teeth to arrowheads. The teeth of a large cat attempting to bite a hunter's linothorax would

probably have struck at a steep angle not unlike that of a plunging arrow, and might well have produced a similarly harmless result. Phrases from this passage are sometimes selectively cited as evidence for the ineffectiveness of linen armor, but when considered in full, it is simply making a comparative statement that linen is less effective than one rather specific and particularly exotic form of armor, and it even asserts that linen is quite effective in another potentially life-threatening situation.

The other passage sometimes cited as evidence that linen armor was regarded as markedly inferior to other types of body armor is Suetonius's account of Galba donning a linen breastplate when concerned about assassination attempts (*Galba* 19–20). As he put it on, Galba despairingly remarked that it "would be of little benefit against so many sword points" (*Loricam tamen induit linteam, quanquam haud dissimulans parum adversus tot mucrones profuturam*). The point of this comment is not that armor made out of linen is of inferior quality but rather that the act of putting on any armor at all is fruitless in the face of such a multitude of enemies. The grammatical structure of the sentence emphasizes that, under the circumstances, any effort at defense is doomed to be futile; the fact that the armor is linen is completely incidental. If anything, this passage could be interpreted as suggesting that linen armor was regarded as relatively good protection, since a Roman emperor would presumably have had his choice of all possible types of body armor. Indeed, the details given in the descriptions of Galba's murder offer explicit testimony to the efficacy of his armor. When the assassins caught up with him, he was pulled from his litter and "lay in his corselet, while the soldiers ran up and struck at him. . . . In this attack, he received many wounds in his legs and arms," but, according to both Plutarch and Suetonius, he was finally slain only when he voluntarily offered his neck to the assassins (Plutarch, *Life of Galba* 27.1–2; Suetonius, *Galba* 20.1). These accounts suggest that Galba's linen corselet provided excellent protection to his torso, deflecting all blows so that he suffered only flesh wounds to his unarmored extremities, until he gave up the struggle of his own accord and exposed his neck.[12]

An explicitly positive statement about the strength of linen is found in Aelian, who mentions that the famously indestructible, floating, waterproof nest of the halcyon bird can no more easily be sawn apart with metal blades than the legendary corselet that the Egyptian king Amasis dedicated to the Temple of Athena at Lindos (*Peri Zoon Idiotetas* 9.17). Linen's extraordinary ability to resist cutting is also stressed by Pliny, who claims that the hunting and fishing nets made of linen at Cumae are so tough that they cannot be severed with knife blades (*Natural History* 19.2.11). Hunting nets made of linen are also recommended for their toughness by Xenophon (*On Hunting* 2.4; 10.1–2).

Testing Other Types of Attacks

We attempted to conduct our arrow tests in a manner that would yield scientifically valid and replicatable outcomes. However, out of curiosity, we could not resist wielding other weapons against the test patches. We did not measure precise results for these tests and fully admit that the methodology employed was not up to rigorous scientific standards; nevertheless, it is worth mentioning some general impressions arising from these tests.

We struck the test patches with a wide assortment of replica swords, spears, axes, and maces of varying degrees of authenticity and sharpness. The patches stood up to slashing blades very well. Although these produced some long cuts through the outermost layers of fabric, none of the slashing blows managed to cut deeper into the slab than about five layers. The demonstrable hardiness of the patches when pitted against slashing blows, as well as the great difficulty we had in cutting the laminated slabs during construction, echoed Aelian's and Pliny's comments about linen's toughness and ability to resist being sliced. Similarly, even powerful two-handed ax and mace blows bounced off the test patches, leaving only minimal damage in the form of shallow dents. The flexible nature of the laminated slab made it particularly good at absorbing and distributing the force of these hits. One can imagine such blows directed at a person wearing a linothorax resulting in unpleasant bruising and perhaps broken ribs, but they would almost certainly not have been fatal. Nor were we able to penetrate the test patches with heavy thrown spears, although we did not have the opportunity to try any lighter javelin-type spears.

The sorts of attacks that proved most effective against the test patches involved sharp, narrow points being driven with great force at an angle perpendicular to the test patch. The weapons that we had the most success with were swords with thin, double-edged blades and spears with narrow points.[13] Whether sword or spear, these were driven into the target using a full-speed, running approach in which the full force and momentum of the wielder's body were employed to drive the point home. It should be noted that the test patches were securely attached to a heavy, weighted, wooden stand that was far more immovable than the body of a human target would have been. In this rather extreme fashion, we were, on occasion, finally able to penetrate the test patch. Such a perfect hit with a running start would have been extremely hard to achieve on a battlefield, unless, perhaps, one were attacking an immobile and unsuspecting foe from behind. The fact that we did succeed in penetrating the armor is less significant, however, than how difficult accomplishing this feat proved to be. The specific circumstances under which

we were able to achieve such a fatal hit nicely recall Pausanias's comment that linen breastplates were susceptible to penetration in war by iron points driven with great force (1.21.7). Overall, our experiments with other weapons suggested that laminated linen offered extremely effective protection against a great many threats, including slicing weapons, blunt trauma weapons, and missile weapons, but that under the right circumstances, it could be vulnerable to straight-on, powerful thrusts by narrow-tipped swords and spears.

Arrow versus Unarmored Warrior

Some sense of how much resistance the test patches offered against arrows (and consequently how much protection armor of the specified type would have given to a hypothetical wearer) can be extrapolated by considering the depth of penetration of the arrows when fired into the foam backing alone without any target patches present. These figures can be compared with the depth-of-penetration data presented in tables 2–20 to suggest the protective effect gained against attack by arrows when wearing linen armor.

Table 1 lists the data for depth of penetration into the foam backing without any intervening test patch for some of our standard arrowheads shot from the three bows at 7.5-m range. These numbers vividly demonstrate the dramatic degree of protection enjoyed by armored warriors versus their unarmored compatriots and serve as a kind of baseline for comparison when considering the performance of the various test patches listed in the subsequent tables.

The numbers in this table can also be considered as roughly approximating the depth of penetration of an arrow into an unarmored human body at the specified combination of bow, arrowhead, and range. As previously noted, when we had the opportunity to experiment with a simulated human torso made out of ballistics gel (which replicates the resistance of human flesh to perforation by bullets or stabbing), the depth-of-penetration numbers were almost always within 10% of the depth of penetration into the foam block target. When the bronze medium leaf point (#4) arrowhead was shot from the 25-lb. bow at a range of 8 m, it penetrated 180 mm into the ballistics gel dummy; when shot from the 45-lb. bow, it penetrated 225 mm into the dummy; and when shot from the 60-lb. bow, the arrow passed completely through the torso of the gel dummy.

Arrowhead Key (numbers correspond to those in fig. 5.1 on page 95)

Numbers in tables represent millimeters of penetration past surface of test patch. Numbers in **bold** indicate potentially fatal hits.

FP, modern field point
ISLP, iron small leaf point #1
IVLLP, iron very large leaf point #2
ILBP, iron large barbed point #3
BMLP, bronze medium leaf point #4
BSLP, bronze small leaf point #5
BSBP, bronze small barbed point #6
HP, modern hunting broad point (see fig. 6.3)

TABLE 1
No test patch (foam backing only): 7.5-m distance

	FP	ISLP	IVLLP	ILBP	BMLP	HP
25-lb. bow	**172**	**231**	**192**	**188**	**192**	**195**
45-lb. bow	**252**	**297**	**298**	**257**	**255**	**252**
60-lb. bow	**365**	**410**	**390**	**349**	**399**	**367**

Arrow versus Test Patch: Test Result Tables

The following tables give the results of the arrow tests.

Tables 2 through 10 give the results for our most "authentic" test patch versus those for a test patch of the same thickness made of modern fabric and glue.

Tables 11 through 16 provide information comparing the performance of a 15-layer laminated test patch against that of a 15-layer test patch whose layers alternate the direction of weave, a 15-layer sewn patch, and a 2-layer quilted patch stuffed with wool.

Table 17 offers data about how a modern hunting broadhead (mounted to a replica wooden arrow) performed.[14]

TABLE 2
7.5-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	5	32	18	21	13	31	13
20-layer (11.5 mm) modern linen	5	35	13	15	12	28	4

TABLE 3
7.5-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	21	42	28	26	40	**55**	17
20-layer (11.5 mm) modern linen	11	**45**	20	28	32	**50**	8

TABLE 4
7.5-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	**80**	**108**	40	39	**120**	**115**	**80**
20-layer (11.5 mm) modern linen	**97**	**102**	**49**	33	**80**	**80**	**66**

TABLE 5
15-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	4	15	12	8	11	18	9
20-layer (11.5 mm) modern linen	3	10	10	6	9	20	4

TABLE 6
15-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	13	**50**	25	23	38	32	36
20-layer (11.5 mm) modern linen	8	42	18	19	33	36	33

TABLE 7
15-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	17	**55**	**45**	30	**45**	31	33
20-layer (11.5 mm) modern linen	13	40	34	26	40	29	34

TABLE 8
30-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	4	5	3	3	10	8	6
20-layer (11.5 mm) modern linen	3	4	3	5	7	8	7

TABLE 9
30-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	13	30	14	8	25	20	23
20-layer (11.5 mm) modern linen	9	25	10	12	23	18	21

TABLE 10
30-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
11-layer (12.25 mm) authentic linen	18	32	21	31	35	27	29
20-layer (11.5 mm) modern linen	9	34	22	23	33	25	27

TABLE 11
7.5-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	5	34	14	10	15	12	5
15-layer (8.25 mm) modern linen sewn, unstuffed	6	32	15	15	23	25	15
15-layer (7.75 mm) modern linen alternating weave direction	5	35	15	14	15	21	15
2 layers quilted stuffed with wool; modern linen (40 mm)	5	**54**	**115**	**65**	**232**	—	—

TABLE 12
7.5-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	12	**52**	25	30	**54**	38	12
15-layer (8.25 mm) modern linen sewn, unstuffed	10	**55**	29	20	**58**	35	18
15-layer (7.75 mm) modern linen alternating weave direction	8	**60**	26	33	**54**	38	37
2 layers quilted stuffed with wool; modern linen (40 mm)	9	**195**	**168**	**75**	**270**	—	—

TABLE 13
7.5-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	**70**	**63**	**118**	**44**	**89**	**181**	**117**
15-layer (8.25 mm) modern linen sewn, unstuffed	**57**	**68**	**89**	**40**	**153**	**202**	**123**
15-layer (7.75 mm) modern linen alternating weave direction	**86**	**70**	**112**	**40**	**80**	**170**	**110**
2 layers quilted stuffed with wool; modern linen (40 mm)	**75**	**253**	**345**	**120**	**322**	—	—

TABLE 14
15-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	4	10	4	4	22	13	9
15-layer (8.25 mm) modern linen sewn, unstuffed	4	14	15	6	35	15	11
15-layer (7.75 mm) modern linen alternating weave direction	4	10	15	8	20	13	13

TABLE 15
15-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	9	**41**	17	18	**43**	29	15
15-layer (8.25 mm) modern linen sewn, unstuffed	5	**56**	15	17	**40**	37	17
15-layer (7.75 mm) modern linen alternating weave direction	11	**60**	19	18	37	31	20

TABLE 16
15-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP	BSBP
15-layer (7.5 mm) modern linen laminated	13	**45**	34	30	**50**	31	29
15-layer (8.25 mm) modern linen sewn, unstuffed	14	**50**	**41**	32	**45**	28	**38**
15-layer (7.75 mm) modern linen alternating weave direction	21	**48**	**43**	**39**	**52**	33	35

TABLE 17
Modern hunting arrowhead: 15-m distance

	25-lb. bow	45-lb. bow	60-lb. bow
11-layer (12.25 mm) authentic linen laminated	40	**49**	**148**
20-layer (11.5 mm) modern linen	33	**58**	**194**
15-layer (7.5 mm) modern linen laminated	40	**110**	**190**
15-layer (8.25 mm) modern linen sewn, unstuffed	**68**	**180**	**293**
15-layer (7.75 mm) modern linen alternating weave direction	**54**	**115**	**220**
2 layers quilted stuffed with wool; modern linen (40 mm)	**163**	**230**	**315**

Linen versus Metal Armor

Finally, to get a sense how our fabric armor might have compared to metal armor, we carried out some limited tests with flat bronze plates. How thick ancient bronze breastplates were is a topic of considerable debate. Even when well-preserved examples

of bronze body armor are excavated and published, often the thickness is not reported, and even more rarely is a chemical or metallurgical analysis performed. Complicating matters yet further is that ancient body armor is rarely of a uniform thickness over its entire surface, and some of its thickness is lost over the centuries through corrosion. Nevertheless, modern estimates usually suggest that ancient Greek bronze cuirasses typically ranged between a minimum of just under 1 mm in thickness and a maximum of around 2 mm in thickness.[15] Among Greek helmets that have been measured carefully, the bronze tends to be thickest near the edges and then thinner across the majority of the surfaces, with overall thicknesses ranging between 0.75 and 1.5 mm.[16] Greek bronze seems to have had a tin content of around 10%, with few trace elements, and was hardened by hammering.[17]

For our tests, we used two thicknesses of bronze plate: one measuring 0.8 mm, to approximate the thinner end of the range of ancient Greek bronze armor, and another measuring 1.8 mm, to represent the thicker extreme.[18] These were fixed to the standard foam block and test stand and shot at with our usual array of bows and arrows. We performed the tests with the bronze plates only at the closest range of 7.5 m, but from these data alone, it is possible to extrapolate comparative performance with that of the fabric test patches.

Metal armor behaves very differently from fabric armor in the manner in which it resists penetration. Slabs of fabric armor composed of many individual layers provide a continual resistance in which each layer must be individually cut, so that the energy required to perforate the slab is directly correlated in a one-to-one ratio with the thickness of the fabric slab. Thus, an arrow will fairly easily penetrate the first layer, but each additional layer requires additional energy to pierce. The slab as a whole undergoes considerable deformation as the arrow bores through successive layers, and the slab can be partially penetrated, with some layers defeated while others remain untouched. Even after an arrowhead penetrates through the final, innermost layer, the glue and fabric slab tends to grip the arrow shaft and continues to absorb considerable energy through friction, thereby serving as an impediment to deeper penetration. A plate of metal armor, on the other hand, constitutes a single, monolithic barrier with a hard exterior surface that will resist all attempts at penetration until a certain energy level is reached, at which point the plate fractures, quite literally splitting open, and an arrow will then pass through with considerably less additional resistance or friction. In some respects, metal armor is an "all or nothing" form of protection in which the arrows harmlessly dent the surface and bounce off up to a certain energy threshold, at which point the metal fractures and the arrows fully penetrate, carrying much of their remaining kinetic energy into the body of the wearer.

For cloth armor, the energy required to penetrate it increases in direct proportion to its thickness; in other words, doubling the thickness of the fabric slab doubles the energy needed to perforate it. For metal plates, however, the energy required to pierce them increases with the square of their thickness, so that, for example, increasing a metal plate from 1 mm to 2 mm in thickness requires approximately a threefold increase in energy to penetrate it.[19]

In our tests, the thin 0.8-mm bronze plate was readily pierced by all arrowheads and bows. Not only did arrows easily fracture the plate, but they also all penetrated alarming distances into the foam backing. Even with the weakest bow, every shot would have resulted in a hypothetical fatal injury. The thicker 1.8-mm bronze plate exhibited a very different performance. All the shots from the 25-lb. bow merely bounced off, leaving only small dents in the plate. All the shots with the 45-lb. bow created fractures in the plate, but the fractures were not wide enough to allow any of the arrowheads to penetrate through fully, and the arrows all ultimately bounced off. All the shots up to this point lacked sufficient energy to reach the critical threshold at which penetration of the plate would be achieved, and thus the plate would have provided complete protection to the wearer. The 60-lb. bow, however, finally produced enough force that the arrowheads all split the thicker bronze plate and

TABLE 18
7.5-m distance, 25-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP	BSLP
Thin bronze plate (0.8 mm)	**92**	**50**	**37**	**28**	**53**	**74**
Thick bronze plate (1.8 mm)	3	3	3	3	3	3

TABLE 19
7.5-m distance, 45-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP
Thin bronze plate (0.8 mm)	**178**	**175**	**102**	**153**	**86**
Thick bronze plate (1.8 mm)	13	21	18	19	16

TABLE 20
7.5-m distance, 60-lb. bow

	FP	ISLP	IVLLP	ILBP	BMLP
Thin bronze plate (0.8 mm)	**296**	**285**	**304**	**201**	**234**
Thick bronze plate (1.8 mm)	**56**	**53**	**34**	**29**	**40**

penetrated to potentially fatal depths. Calculations of the energy required suggest that around 72 J were needed both to crack the 1.8-mm plate and to allow the arrowhead to penetrate to a potentially fatal depth.[20]

In comparison with the fabric armor, the resistance of the 0.8-mm plate to penetration was grossly inferior in every way. The performance of the 1.8-mm bronze plate, however, was roughly equivalent to that of the laminated 20-layer 11.5-mm-thick test patch. Our recorded energy figures for arrows that just managed to pass through the 20-layer laminated patch to a potentially fatal depth were typically around 65–75 J. This suggests that a standard laminated linothorax would have provided about the same protection against arrows as a bronze cuirass whose thickness was toward the upper end of the attested range. The linothorax, however, would have had two substantial advantages over the metal cuirass. First, its layers seem to have offered much greater frictional resistance to further piercing by arrows, and thus a much more powerful shot would have penetrated a considerably shorter distance into a linothorax wearer's body than the same shot would have plunged into a metal-cuirass-wearing warrior. Second, the weight of a 20-layer 11.5-mm-thick laminated linothorax would be only about two-fifths that of a 1.8-mm-thick bronze cuirass.[21]

Tables 18 through 20 give the test data for the bronze plates.

Wearability Issues

Although literary references to armor made of linen survive, and hundreds of vase paintings and sculptural reliefs depict Type IV armor, we lack any firsthand commentaries or accounts by a soldier describing what it was like to wear a linothorax. Therefore, we were forced to extrapolate the practical qualities of the armor in the field based on our own personal experiences. As part of our investigations into this type of armor, we made six full-size reconstructed linothorakes and wore them for extended periods of time while performing a variety of physical activities (fig. 7.1). We have similarly worn other types of reconstructed armor that were common in the ancient world, including a chain mail shirt and a Roman *lorica segmentata* of the Corbridge pattern. These experiences have provided the basis for our observations regarding not only the wearability of the linothorax but also its advantages and disadvantages compared to other types of contemporaneous body armor.

The particular materials and construction methods of the linothorax give it some distinct advantages over metal armor, but they also create some potential liabilities not shared by traditional metal cuirasses. This chapter considers the unique characteristics, both positive and negative, of the linothorax in terms of its durability, ease of repair, and the effects of its design and construction on a soldier's mobility and endurance. It begins with an examination of the most obvious potential liability of armor made of cloth and glue—its likely vulnerability to moisture.

Potential Vulnerability to Moisture

One important factor that has not yet been discussed is the durability of the laminated linothorax and, in particular, the potential vulnerability to moisture of armor made primarily of cloth and glue. In order for a linothorax to function as viable armor for armies on extended campaigns such as Alexander's, it had to be tough enough to withstand considerable hard usage on the march, it had to be unaffected by extremes of temperature, and it had to be able to endure wet conditions. One advantage of the linothorax is that, while all fabrics are to some degree susceptible to eventual degradation from exposure to moisture, linen is especially hardy in this regard. It does not swell or unravel in water, and its tensile strength actually

Fig. 7.1. Four of our six reconstruction linothorakes. Even when made from the same basic pattern, each of our corselets ended up differing from the others, and we suspect that there was a similar lack of standardization among ancient warriors.

becomes greater when the fibers are wet. Compared to other common textiles, linen does not stretch out or lose its form when exposed to water. Finally, if it does become saturated by immersion in water, linen dries very readily. All of these characteristics make it an attractive fabric in nautical contexts, such as for fishing nets or cordage on boats, and exactly these types of uses are indeed stressed by ancient authors.[1] In terms of durability, our own experiments demonstrate that laminated layers of linen can be flattened out and then bent again over and over for years without the slab breaking or the layers becoming separated from one another. Therefore, there is nothing intrinsic either to linen as a material or to the lamination process that would rule out a reasonable life-span in the field for armor made of linen, even under wet conditions.

The factor that might pose a serious threat to armor such as the linothorax stems not from the fabric but from the glue used to bond the layers together, which might prove vulnerable to moisture. A sewn linothorax held together primarily with stitching would not have had this particular problem but could still have suffered damage from wetness through long-term degradation of the fibers. Most of the common glues discussed so far, including rabbit glue, flax seed glue, and PVA glues, are, to varying degrees, soluble in water. A linothorax constructed using such glues would probably have survived an occasional rainstorm or even a brief

immersion in water.[2] On a long campaign, however, or one in areas with a tropical climate such as Alexander's army would have experienced in India, prolonged exposure to high humidity or a sustained torrential downpour could potentially have caused the glue to start dissolving and the layers literally to fall apart. In certain circumstances, even a soldier's own sweat might begin to affect the structural integrity of his armor.

Taking the campaigns of Alexander as an example, it is clear that the soldiers' armor had to possess fairly good resistance to water. When crossing a river unopposed, it might be possible to ferry arms and armor across on rafts or boats to prevent them from getting wet. Similarly, when it rained during routine marching, it might have been possible for the soldiers to protect their armor from the rain with cloaks or other garments, or they may even have removed their armor and piled it in covered wagons or on horses where it would not have been directly exposed to the elements. When there was time, Alexander often built bridges to cross major rivers, and this not only would have been safest for his army but would also have helped to establish lines of supply and communication.[3]

There were, however, numerous instances when Alexander's army, or parts of his army, plunged across a river in combat situations where the soldiers would certainly have been fully equipped and wearing their armor. For example, at the city of Pelium, elements of Alexander's army, including hypaspists, archers, and part of the phalanx, forded the river Eordaicus on foot in the face of the enemy. When threatened by a counterattack, the archers were even ordered to open fire from midstream (Arrian, *Anabasis* 1.6). While the water here clearly must have been relatively shallow in order for archers to be able to work their bows while standing in the river, there are multiple examples of Alexander's army crossing even deeper waters in combat situations. At the Tanais River, the far bank was strongly held by the Scythians, but under cover of a catapult bombardment, Alexander's light troops crossed the river using animal skins as floats, accompanied by squadrons of cavalry (Arrian, *Anabasis* 4.4).[4] The Danube was similarly crossed by his entire army despite the presence of a hostile enemy on the far bank by employing a mixture of boats and tents stuffed with hay to make flotation devices (Arrian, *Anabasis* 1.4).

River crossings directly in the face of the enemy featured prominently in no less than three of Alexander's four great set-piece battles. First at the Granicus, contrary to standard tactical wisdom, Alexander successfully charged with the cavalry and light troops across the river and uphill against his foes (Arrian, *Anabasis* 1.15). The main body of the phalanx following behind is described as marching across the river on this occasion (Arrian, *Anabasis* 1.16). A similar sequence was repeated at the Issus, with identical results (Arrian, *Anabasis* 2.10–11). Finally, at the Battle

of the Hydaspes, the army not only traversed the swollen river to engage the enemy but had been subjected to torrential rains since crossing into India, and Arrian states that it had been raining immediately before the battle (Arrian, *Anabasis* 5.10, 5.13; Plutarch, *Alexander* 60). It is specifically mentioned that, during this crossing, the fully armed infantry had to wade through waters that were chest deep.

While the unusual length of Alexander's expedition made the need for waterproof (or at least water-resistant) armor particularly acute, it would have been a significant consideration even during shorter campaigns. There are numerous incidents of Greek armies similarly having to march for prolonged periods while exposed to rain or having to cross rivers during campaigns. Just to cite one example, at the beginning of the Peloponnesian War in 431 B.C., the Theban forces at Plataea encountered both of these situations. The Thebans in the city had to fight a confused action all night long against the townspeople, during which "a heavy rain" fell (Thucydides 2.3–4). Thucydides vividly describes the muddy chaos that resulted from the combination of rain and darkness. Meanwhile, a Theban relief force was making its way to Plataea, but these soldiers had to march all night through the downpour, and if this were not enough, they also had to ford the rain-swollen waters of the Asopus River (2.5). Certainly the Thebans in the city would have been wearing full combat gear, and as the relief force was marching through hostile territory in a confused situation, it too presumably would have been advancing in battle order, ready for combat. Thus, both groups would have been wearing their armor through hours of strenuous exertion in heavy rain and even while immersed in water.

Another context in which waterproof armor would have been important was on board warships. There, the constant exposure to the dampness typical of wooden ships, as well as direct contact with sea spray, waves, and rain, would have made waterproof armor a necessity. While most individuals aboard warships were rowers, Greek, Persian, and Hellenistic ships also carried contingents of hoplites, archers, and marines.[5] According to Thucydides, the standard crew of an Athenian trireme included 10 hoplites and 4 archers (3.98.4). With their skill as mariners, the Athenians seem to have chosen to maximize ship performance by cutting down on personnel not immediately involved in handling or propelling the ship, but other navies opted for larger contingents of fighting men. The Persians were said to carry 30 soldiers plus an unspecified number of marines, Chian triremes bore 40 hoplites, and, at various points, Corinthian triremes had 27 and 38 hoplites each.[6] Unfortunately, the surviving evidence for what these soldiers wore as body armor is practically nonexistent, but there is one mention in Herodotus that Phoenician

marines in the Persian navy during the invasion of Greece were equipped with "Greek-style helmets and corselets of linen" (7.89). As long as it were waterproofed, linen armor would have been an appealing choice for shipboard fighters because, if one were unfortunate enough to fall overboard while wearing it, its lighter weight compared to that of a heavier bronze cuirass would have offered a better chance of not being immediately dragged under the waves.

Waterproofing Experiments

Because a substantial proportion of Alexander's soldiers were probably equipped with linothorakes, the examples of Alexander's army crossing rivers and fighting in the rain indicate that ancient linen armor was able to endure repeated immersions without significant damage. The two most obvious ways that such water resistance could have been achieved if the linen were laminated are either by constructing the armor with glues that are not soluble in water or, if water-soluble glues were used, by applying a waterproofing agent to the finished armor. We suspect that the first possibility is the more probable one, and that a type of adhesive was employed that did not dissolve when exposed to water. Unfortunately, our ignorance of the exact recipes for ancient glues prevents us from being able to re-create such an adhesive. As discussed in chapter 3, ingredients such as bitumen, bark pitch, and animal grease are attested as having been employed to make strong and waterproof glues in the ancient Mediterranean world, but the precise formula and process remain a mystery. For our reconstructions, we were therefore left to evaluate the second possibility: that the armor was somehow waterproofed. There was a range of possible waterproofing agents known in the ancient world that were cheap and widely available. Among these were tree products (such as pitches) and animal products (such as waxes and oils). We experimented with three of these—pine resin, lanolin from sheep's wool, and beeswax—all of which can be turned into liquid or semiliquid forms and poured or rubbed onto the outer and inner surfaces of a completed linothorax.

In order to assess the waterproofing potential of these substances, we constructed a number of small 10-by-10-cm 18-layer laminated patches using PVA glue, and 15-layer laminated patches made with rabbit glue. We then treated the patches with various waterproofing agents, using different application methods. One patch was covered with melted pine resin, and another with melted beeswax. Several were rubbed with a block of beeswax, while others had a coat of lanolin manually applied. As controls, we used patches laminated with PVA and rabbit glue with no waterproofing agent applied.

Pine resin was easy to melt, but problematic to daub onto the patches. It was extremely sticky in its liquid form, rendering it difficult to work with, and it cooled rapidly, making it hard to spread evenly. It also retained its stickiness even when dried, causing the patches to collect dirt and lint. When cooled, the resin formed a fairly hard crust, which, when the laminated slab was bent sharply, developed cracks. We were initially concerned that these cracks either might be deep enough to admit water to the underlying fabric or, over time, might multiply and cause the resin to flake off. However, closer inspection revealed that the cracks did not penetrate all the way to the fabric and that, even when the patch was completely immersed in water, they did not allow the water to seep in. Also, because the resin retained a certain rubbery quality, if one vigorously rubbed the surface of the pine resin-covered test slab with a cloth using a circular buffing motion, the cracks disappeared. The greatest potential problem with employing resin in a Mediterranean climate is that it transforms from a solid to a liquid state at relatively low temperatures. At temperatures over 30°C (86°F) the pine resin began to grow soft, and over 37°C (100°F) it developed a gooey consistency. Although it may be possible to combine resin with some other ingredient to counteract this tendency, in the absence of definite knowledge about such a procedure, we concluded that pine resin could function as an effective long-term waterproofing agent only in cooler climes.

Pure lanolin is a viscous substance similar in appearance and consistency to petroleum jelly. Found in the fibers of the coats of goats and sheep, it is extracted by being pressed from the wool after the animal has been sheared. Thus, the widespread use of wool in the ancient world would have ensured its ready availability. Its greasy consistency made it easy to apply by simply rubbing it onto a test patch. The lanolin was rapidly absorbed by the linen and penetrated beyond the first layer to at least the underlying one. One negative feature of lanolin was that, even after the saturated layers had been rubbed with a dry cloth, the surface of the patch retained a slightly unpleasant, greasy texture. This greasiness was easily transferred to one's hands or to anything else that happened to rub up against it, a particularly unwelcome effect for a soldier who needs to maintain a firm grasp on weapons.

Beeswax turned out to be the most versatile of the waterproofing agents. Unlike pine resin, beeswax was stable as a solid even up to temperatures approaching 60°C (140°F), but it melted quickly over a fire and spread over the patches readily. It also lacked the stickiness of resin, which made it easier to work with and to clean up. When the beeswax-covered patches were bent, they had a reasonable range of flexibility before cracking began, and major cracks were quickly and easily repaired by buffing in a similar manner to the pine resin.

We also found that the beeswax could be applied by an even simpler method. If one rubbed the wax block directly onto the fabric test patches, the wax adhered to the fibers of the fabric. Doing this for a prolonged time created a steadily thickening layer of beeswax on the patches, up to 1 or 2 mm in thickness. Even a fairly cursory rubbing, however, transferred sufficient deposits of wax onto the patch to render it water-resistant and able to repel a moderate rain. One can imagine soldiers carrying around a small block of beeswax and periodically buffing a new layer onto their armor as part of regular equipment maintenance, similar to the way that bronze or iron armor required frequent polishing. Although the beeswax was carefully rubbed over all the surfaces of the test patches and seemed to coat them completely, subsequent water tests revealed that small fissures unnoticeable to the naked eye must have formed when the beeswax was applied using this method. An interesting side effect of the beeswax was that it imparted a slight but perceptible honey scent to the linen, which could well have been an agreeable attribute in a densely packed mass of sweaty men.[7]

All of these test patches were first subjected to a simulated hard, steady rain using a controllable sprinkler. The patches were arranged on a stand at a 45-deg. angle to the ground, with the simulated rain striking them perpendicular to their front surfaces. The patches were subjected to 12 hours of continuous "rain" and were periodically examined in order to assess the effects of this exposure. As a final severe test of their resistance to water, immediately following the rain test, all the patches were completely immersed in buckets of water for 3 hours. These tests were intended to model a fairly extreme field situation in which a linothorax-wearing soldier had to endure 12 hours of continuous, heavy rainfall without any shelter or protective garments, and then wade or swim through a substantial river or swamp.

There were clear differences among the various test patches when they were exposed to our simulated wet conditions. The untreated control patches absorbed water quickly, and within 2 hours the water seemed to have seeped through even an 18-layer PVA glue patch. In this state, the saturated patch lost its rigidity and became soft and flexible, bending slightly even under its own minimal weight. When it was squeezed, the water that emerged clearly contained dissolved glue. After 12 hours the edges of the outermost layer, which obviously had had most of its glue rinsed away, began to separate from the next layer and peel back of their own accord. Although much of its glue had plainly returned to a liquid state, we were surprised that the control patch did not disintegrate, nor did any but the outermost layers begin to delaminate from one another; it held its shape even in its totally saturated condition.

The fabric of the lanolin-saturated patch absorbed water much more slowly than the untreated ones, but nevertheless, after 2 hours the outermost layer of linen was becoming waterlogged. By about 8 hours all of its layers had become saturated, and it also lost its rigidity, and by 12 hours the edges of its outermost layer were beginning to come unglued. Nevertheless, it too held its basic shape throughout the 12-hour ordeal. Lanolin cannot be considered a true waterproofing agent but could be described more accurately as rendering the patch water-resistant.

The various patches coated with resin and beeswax proved to be quite waterproof. For at least the first 6 hours, water simply beaded up and ran off the surfaces of all of these patches with no perceptible penetration of the coating. After this point, however, perhaps by seeping through tiny holes or cracks, water seemed to slowly penetrate into both the resin patch and the patch that had beeswax rubbed onto it. After 12 hours, water had soaked the outer layers of these patches and the inner layers had become damp. Accordingly, these patches started to lose some of their rigidity, although not nearly to the same degree as the previously described ones. The resin patch appeared to be somewhat more extensively saturated than the beeswax one.

The patch that was most waterproof was the one that had beeswax melted onto it. It was the only one whose fabric remained completely dry and which retained its initial rigidity throughout the entire 12 hours of simulated rain. We believe that the melting procedure resulted in a solid layer of uniformly thick beeswax, whereas rubbing with wax produced a more uneven coating, whose thinner areas allowed the water to eventually gain entrance to the patch.

As a more extreme test of waterproofing that would replicate the sort of complete, prolonged immersion that might occur when an army forded a river or when soldiers were crossing back and forth repeatedly through a river carrying equipment or supplies, we took the patches in the condition in which they emerged from the rain test and completely immersed them in buckets of water for an additional 3 hours. In their waterlogged state, all of the patches sank to the bottom except for the melted beeswax one. This was yet further evidence that it had not been penetrated by water. In order to subject it to the same conditions as the other patches, however, we attached it to a weight so that it was held suspended beneath the surface of the water. After half an hour, all of the patches except the melted beeswax one had reached a similarly saturated state in which water seemed to have penetrated all the layers and the glue had sufficiently liquefied such that the patches were soft to the touch and easily bent. At this same point, the melted beeswax patch began to show signs of water seeping into the fabric. After 1 hour, the melted bees-

wax patch lost its buoyancy and sank to the bottom with the others, although it was still completely rigid. After 2 hours, the outer layer of the untreated PVA patch and of the lanolin patch began to visibly detach from the rest of the slab. After 3 hours, water appeared to have penetrated the layers of the melted beeswax patch, although it was still fairly stiff. The other patches were totally saturated, but all held their shape, and only in the untreated PVA patch and the lanolin patch had the outer layer become partially detached.

Most interesting was how the various test patches dried. The untreated PVA and rabbit glue patches were completely dry after only 8 hours and, remarkably, recovered nearly all of their former integrity. The patch made of a very water-soluble PVA glue lost about half its outermost layer, but once dry, the other 17 layers were still tightly bonded and showed few signs of their immersion. The loose flaps of the outermost layer could be repaired very quickly with a few dabs of glue. The untreated patch made with rabbit glue survived even better. It too dried quickly and, once dry, it resumed its original rigidity and shape without even any edges having come loose. The waterproofing agents applied to the other patches, however, caused them to retain water and accordingly to dry out very slowly. The lanolin patch took 3 days to dry fully, and the beeswax and resin patches were still completely soft and waterlogged after a week. It took 3 to 5 days in the sun for them to fully recover from their immersion, and the beeswax-coated patch made with rabbit glue showed signs of mold growing within its layers.

The results of the waterproofing tests were surprising to us. Contrary to what we had expected, the untreated patches' quick recovery from immersion suggests that linothorakes made with water-soluble glues would have been much hardier than anticipated and might well have survived repeated soakings without losing either their shape or their protective qualities. The patches with melted beeswax were quite effective at keeping water out, but unlike the untreated samples, if penetrated, retained the water for an undesirably long period of time. Overall, these experiments suggest that, in extremely wet environments in which armor was subjected to complete immersion or torrential rains for extended periods of time, an "all or nothing approach" was probably best. Thus, one would have either applied a high-quality waterproofing agent very carefully and thoroughly with the goal of completely preventing water from penetrating or else left the linen in an untreated state with the idea that it would get wet rapidly but would also dry out readily, and that any minor damage could be easily and quickly repaired on the spot. In more moderate climates featuring occasional rainfall or brief immersions, a high degree of water resistance could have been imparted by a light rubbing with beeswax. Either way, these tests

demonstrate that the potential damage caused by rain or immersion was not great enough to render even linothorakes made with water-soluble glues a significantly inferior choice of armor in terms of durability.

Just as potentially damaging to the linothorax over the long term as rainwater is the sweat generated by the human body in hot climates. While the amount of sweat produced can vary greatly from person to person, we found that it was just as important to waterproof the inner surfaces of the linothorax as the outer ones in order to protect the armor from the wearer's own body moisture. Because of the ease of use of all the waterproofing agents we experimented with, however, this inside and outside waterproofing treatment presented no practical difficulties.

Durability and Repair

Two related considerations that are important in assessing the utility of any type of armor are how well it resists day-to-day wear and tear, and how easy it is to repair when it suffers damage in battle.[8] Many types of metal armor, while highly effective, require a considerable expenditure of time and effort to maintain in an ideal condition. Soldiers often have to spend long hours polishing, buffing, and scraping it in order to combat rust and corrosion. Preventing corrosive phenomena such as rust is not merely an aesthetic issue because, if untreated, they can eventually affect the structural integrity of the armor. In the short term, rust or corrosion can render features such as hinges and clasps inoperable. An armor's ability to be repaired after sustaining battle damage can also have significant military and economic implications. If a piece of armor lost its essential functionality after being dented or holed even once and had to be replaced, this would have been a costly proposition. Similarly, if repairs were expensive or required the services of a specialist, this could be a drawback when on campaign or where the necessary time, material, or expertise to make repairs was not readily available. Finally, there is the question of how much protection repaired armor offered compared to a pristine example. Did the repairs leave a permanent weak spot, or did they fully restore the armor's original protective ability?

In regard to all of these issues, the linothorax appears to perform well. We have had our oldest linothorakes for about five years, and while they have by no means been worn continuously, they have been worn numerous times, in physically strenuous situations, for prolonged periods of time, and in temperatures ranging from 38°C (100°F) to below freezing. Throughout all of this, they have displayed good durability. Despite being repeatedly bent and straightened, the laminated layers have shown no tendency to crack or separate. The main difficulty encountered was

that the thin leather cords we initially used to secure the sides together and to tie down the shoulder flaps proved to be too thin to stand up to the stresses produced when moving vigorously in the armor, and these repeatedly broke. The solution was to double up the cords or to use thicker leather thongs for the ties; these have worked fine.

Nevertheless, the way in which the ties holding down the shoulder flaps are exposed across the chest of the wearer does constitute a weak point in the design. A hit or, especially, a slashing blow could easily sever these cords, causing the flaps to spring upright into the vertical default position so often observed in vase painting scenes of warriors putting on the armor. The lid of an Etruscan bronze cist actually depicts exactly such a situation, in which a warrior wearing Type IV armor is being trampled under the front legs of a rearing horse. Its hooves are striking the warrior in the chest and have apparently severed the exposed cords holding down the shoulder flaps. The flaps are shown jutting vertically above the wearer's shoulders, with the ends of the cut cords flying free.[9] That the artist could include this episode and expect his viewers to understand what was happening suggests that such mishaps were a fairly common battlefield hazard of this type of armor.

We have found that the white surface of armor made with bleached linen is somewhat difficult to keep clean under field conditions; while linen is particularly good at shedding dirt, the armor is prone to picking up scuff marks from other equipment rubbing against it. Similarly, the red paint we used to outline some of the edges of the armor also had a tendency to leave reddish smudges on the white bleached linen in spots where a part of the armor with the red paint repeatedly rubbed against it. This occurred in various places in the course of normal walking or running motions, and especially where the underside of the shoulder flaps rubbed against the chest. While bleached linen yields a visually striking and attractive piece of armor, it does seem impractical for a prolonged military campaign. A linothorax that we made with natural, unbleached linen, however, seemed far more suited for extensive use in field conditions. Its fabric had a natural greenish-tan or khaki color that, when exposed to mud and dirt, matched them so closely in color that discoloration and staining were hard to detect. The natural linen color also would have offered effective camouflage, particularly in arid or rocky environments.

One situation in which armor made of fabric turned out to be less durable than metal was when we wore the linothorax for many hours while also burdened with other types of military equipment and weapons secured with belts or straps. When marching, we found that the metal parts of the belts and weapons sometimes had a tendency to chafe against the fabric surface of the armor, and over time this chafing

began to abrade portions of the outermost layer of linen. For example, when one of us wore a sword on a baldric that had a sharp projecting edge as part of its scabbard, this edge started to scrape away at one specific spot on the armor that it repeatedly rubbed against over the course of a 3-day reenactment event. While this abrasion was only faintly discernible at the end of the three days, one can imagine that, after several weeks of such treatment, the outermost layer of fabric might be worn through. Although it would probably take months or even years for such abrasion to seriously compromise the integrity of the armor as a whole, this is a type of damage to which metal armor would be much less susceptible. Fortunately, it is also a form of deterioration that can be easily and quickly remedied. Simply gluing another layer of fabric over the abraded area both fixed the damage and restored the original appearance of the armor. Such a repair takes only minutes, is cheap, can be done by someone with no specialized skills or equipment, and is completely effective. Thus, this kind of ordinary wear-and-tear damage to the linothorax could have been fixed in the field by the soldiers themselves with very little effort.[10]

The next consideration is more serious damage caused by enemy weapons in battle. There are three basic types of battle damage: dents, indentations, or bent sections of armor caused by blunt-force attacks, such as by a mace or shield edge; broad but usually shallow slices inflicted by the cutting edges of various weapons; and holes that extend either partially or completely through the armor, produced by arrows or by sword or spear thrusts.

We experimented with repairing all three types of damage. The first were the easiest to deal with. Because of the inherent flexibility of the linothorax, large dents or bent sections of armor could simply be popped out or pushed back into shape by hand with no apparent ill effects. Small indentations also had a tendency to slowly disappear over time as the armor was worn. The contrast with metal armor was very dramatic, because dented or bent metal armor often requires a forge and the professional services of a blacksmith.

Probably the most difficult type of damage to repair was the second kind, resulting from slashing attacks by sharp cutting edges, such as from our replica *kopis*. No slashing attack ever managed to penetrate more than about a quarter or a third of the way through any of the laminated test patches, but the cuts produced by these weapons could be up to 20 cm long. We used a similar method of repair: pouring glue into the cut, filling it with fabric (if necessary), and resurfacing it with several new layers. While this remedy seemed effective, the cut probably did still constitute a minor weak spot in the armor. The danger posed to the wearer would have been negligible, however, because it would have taken at least three or four powerful

slashes striking one after the other in precisely the same spot, at exactly the same angle, to penetrate the armor—an extraordinarily improbable event.

Finally, actual holes in the linothorax, such as those made by arrows, proved relatively easy to fix. First, the inwardly deformed section of armor was pushed back level with the surrounding armor. Then linen scraps soaked in glue were stuffed tightly into the hole, followed by a further liberal application of glue. The smooth appearance of the surface of the armor could be restored by covering the plug on both the inside and the outside with small, round patches of a layer or two of fabric. Although it was difficult to hit the repaired spot precisely with a second arrow, the patched section of armor did not seem to be more vulnerable to penetration than pristine armor. This repair method worked whether the hole went all the way through all the layers of the linothorax or just partially.

The instances when one of us was shot multiple times with arrows while wearing a replica linothorax provided a particularly realistic opportunity to explore this kind of repair. After we fixed the individual holes, the entire front of the linothorax was given several new layers of linen. Thus, a linothorax that had suffered fairly extensive damage from many arrows could be restored to its original appearance. One can easily imagine an ancient warrior being shot repeatedly in combat so as to resemble a pincushion, but then being able to return his armor to battle-ready and apparently unscathed condition in just a few hours.

The ease of fixing all these types of battle damage is another significant advantage of the linothorax over comparable metal armor. In all these cases, fixing metal armor would have required specialized equipment and the services of a trained metalworker. In contrast, the linothorax could be repaired by the soldiers themselves with inexpensive materials that were likely ready to hand. The linothorax also has a distinct advantage in terms of repairability when compared to leather armor. A hole or cut in leather can be sewn together, but the basic hole still remains even if the edges are held together with stitches; thus, the damaged section will not have the same resistance to attacks that it originally did. A better option would be to sew up the hole and then apply a patch over the affected area, which would give the wearer at least the original degree of protection. If done many times, though, the result would be highly visible repairs and a potentially ill-fitting garment. In contrast, the linothorax can be easily and repeatedly returned to its original protective ability and appearance. In sum, fixing battle damage to the linothorax is uncomplicated and fast, requires no particular skills or specialists, and fully restores the structural integrity of the armor.

Range of Motion, Mobility, and Fit

Another attractive quality of the linothorax is the overall range of motion and mobility that it affords its wearer. As long as the shoulder pieces are not cut too wide, the armor allows the soldier a full range of unhindered movement for both of his arms. In particular, it does not restrict over-the-shoulder arm motions essential for such activities as throwing spears and javelins or using a sling. Therefore, a wide variety of ancient soldiers, including missile troops, skirmishers, light infantry, archers, heavy infantry, and cavalry, could potentially have been equipped with the linothorax, performed their duties on the battlefield, and still enjoyed a reasonable degree of protection from attacks. When wearing the linothorax, a soldier can also fully rotate at the hips. This near-complete range of movement would have been a great advantage when fighting hand to hand in the thick of battle and when undertaking other common battlefield actions, such as scaling city walls.

Also, in contrast with some types of heavy metal armor (which renders natural movements somewhat cumbersome), the linothorax lets the wearer bend fully at the waist, allowing him to retrieve dropped items or pick up objects on the ground. This flexibility is recorded by ancient vase painters, who show Type IV-clad warriors bending completely over to affix their greaves. (It should be noted that this bending ability does become impaired if the lower edge of the armor extends too far down the lower abdomen, but this is a matter of properly fitting the armor to the individual wearer.)

Since well-fitted armor allows the soldier to bend at the waist and have unhindered motion at the hips, the linothorax could also be worn by a soldier on horseback. Because the Greek horseman lacked stirrups and had to grip the horse using only his thighs and lower legs, any additional weight toward the top of the soldier (e.g., a bronze cuirass) would have exerted a dangerous destabilizing effect—especially at full gallop or when leaning to one side or another while attacking or defending oneself in combat. Because of its lighter weight, the linothorax would minimize this potential top-heaviness. For mounted warriors, the linothorax could be worn comfortably, would allow the cavalryman a full range of motion for striking, and would make it easier to mount and dismount. Not surprisingly, there are depictions of Greek, Persian, and Macedonian cavalrymen all wearing this form of armor (see figs. 4.6, 7.2).[11]

In Alexander's campaigns, his *sarissa*-armed cavalry and the elite Companion cavalry were routinely employed in the role of shock cavalry in order to charge and break enemy formations, including heavy infantry. They also frequently engaged in melee-type combat with enemy cavalry units in which thrusting and hacking

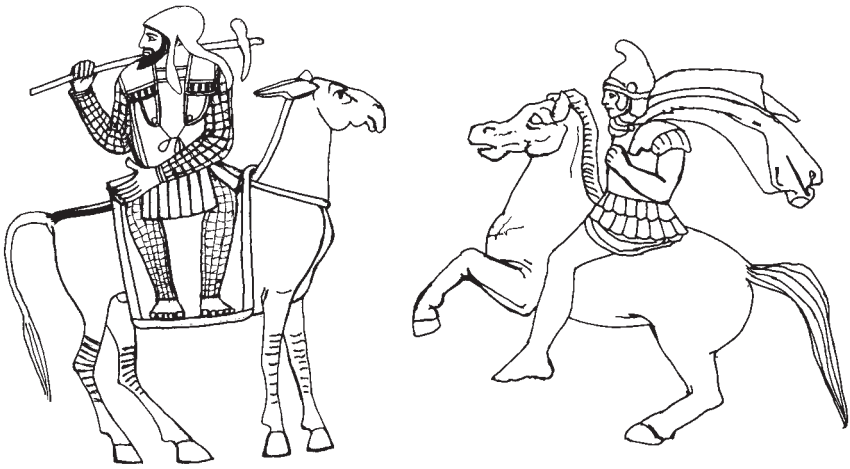

Fig. 7.2. Persian equipped with a Type IV corselet rides a mule (*left*), and in a stone Hellenistic-era relief, a Thessalian cavalryman also wears one (*right*). (*Left*, R-158; *right*, S-21)

attacks could come from any side, and a warrior could not rely on his weapon to keep the enemy at a distance. While there is no consensus about what armor was worn by these troops, it seems obvious that having some form of body armor would be highly beneficial in order to fend off or mitigate the effects of unseen and/or unblocked blows, especially if such armor did not significantly impair mobility. Among the images of soldiers wearing the linothorax on horseback is at least one mounted archer, a type of warrior who requires a considerable range of motion and flexibility to effectively use his weapon.[12] The versatility of the linothorax for a wide range of troop types is attested in the ancient sources, which show or mention it being used by infantry, skirmishers, cavalry, and marines.[13]

The linothorax is pleasant to wear. It is relatively lightweight compared with other types of armor and does not weigh down any one area of the body or cause the body to feel strained after wearing it for an extended time. Its flexibility allows the wearer to personalize the fit of the armor to his body shape and size by adjusting the side and shoulder ties. With metal armor, if a particular curve does not happen to match that spot on an individual's body, he is simply stuck with armor that is perpetually uncomfortable (and can quickly rub his skin raw in ill-fitting areas). When wearing the linothorax, we found that only a light undershirt, akin to a tunic or *chiton*, was necessary to prevent chafing. Wearing such an undergarment seems to have been standard practice for ancient soldiers, as can be seen on numerous vase paintings depicting soldiers at different stages of putting on their

gear. In all cases, the typical garment worn under the linothorax was a loose-fitting tunic or *chiton* similar to that worn in everyday civilian life. Again, this would have increased both the comfort and the endurance of the wearer, because it was not necessary to wear hot, thick padded garments underneath the armor as was required with some metal cuirasses. Additional clothing or padding worn under the linothorax may have been the personal preference of some ancient soldiers, but the vase paintings suggest that this would have been atypical.

Perhaps one of the most pleasant surprises we discovered about the linothorax was that when we wore it for extended periods of time in warm weather, the heat caused the glue to become slightly soft, which resulted in the linothorax molding itself even more finely to our particular body shapes. One's own body heat generated during prolonged, rigorous physical activity also produced this same softening of the glue and caused the armor to subtly conform to one's individual proportions. This unanticipated effect rendered the linothorax extremely comfortable to wear, even for prolonged periods of time.

Another positive characteristic of this type of armor is that it does not absolutely require an extra person to help put it on. It is certainly easier when another person lends a hand in tying the cords, but this assistance is not essential. Most probably, soldiers helped one another with their armor. An entire army utilizing the linothorax could have been completely self-sufficient when arming for battle. This makes perfect sense when we consider that Philip II reduced the number of servants the Macedonian soldier could bring along with him to one servant for every 10 soldiers, thus practically forcing the common infantrymen to dress themselves or each other.[14]

Storing the armor would have been straightforward as well, and there were various ways this could have been done. Linothorakes could have been kept in a laced-up position, as they would sit on a soldier, and then either hung on a *tropaion*-like structure consisting of an upright post with a crossbeam or simply placed upright on the ground. Linothorakes being carried in this state are depicted on several vases (see fig. 3.3).[15] It seems that they could also be rolled up into a tight bundle with the shoulder flaps left untied and sticking upward; other vases illustrate this option (fig. 7.3).[16] Alternatively, the armor could be completely unrolled so that it resembled a flat sheet and then stored in this form. This flattened state would be a particularly efficient way to stockpile or transport large numbers of linothorakes, because they could be stacked one on top of another. Dozens or even hundreds of linothorakes could be carried in a wagon in this flattened and stacked form.

Fig. 7.3. Thetis bringing Achilles his armor (*left*), and man carrying a rolled-up Type IV corselet (*right*). These images suggest that such a rolled-up state might have been one typical way that this armor was stored. (*Left*, R-68; *right*, R-81)

Heat, Weight, and Endurance

Even when linen has been transformed into a laminated slab, many of its attractive qualities seem to have been at least partially retained. Not least of these is linen's ability to remain cool and breathable in very hot and/or humid weather. In the Mediterranean and ancient Near East, hot summer temperatures can become a significant factor affecting the endurance and mobility of troops both in battle and on the march. One of the great disadvantages of metal armor is that it readily absorbs heat. Such armor can become so hot that it will literally burn skin that it comes into contact with, and thus it becomes awkward or even dangerous to handle or wear in sunny conditions. Even worse, when metal cuirasses are exposed to direct, strong sunlight, the metal absorbs and intensifies the resultant heat, effectively transforming them into miniature ovens that bake the unfortunate soldiers enclosed within them. When this characteristic is combined with the extremely arduous physical exertions of combat, a soldier can become overheated and dehydrated in a surprisingly short period of time.[17] Similarly, soldiers who have to march for extended periods encased in metal armor will suffer much greater exhaustion and have a shorter marching range than unencumbered troops.

In contrast, linen does not heat up appreciably when exposed to direct sunlight, and the innate breathability of the fabric allows any built-up heat to dissipate quickly. As a result, the linothorax can be worn in sweltering conditions for many hours on end without the wearer suffering contact burns or becoming exhausted as a result of high temperatures. One of the authors (Bartell) has worn several of the reconstructed linothorakes during intense midsummer heat on three occasions, while continuously performing a series of energetic and random physical exercises, including crouching, throwing, jogging, and running, without noticeable discomfort. Also, moisture evaporates from linen particularly readily, so even when the laminated fabric became soaked with sweat as a result of heat or exercise, we found in our experiments that the armor very quickly dried out, especially when left in direct sunlight.

The most obvious advantage of the linothorax over comparable bronze armor is, of course, its lighter weight. The weight of our most realistic reconstruction, which had a thickness of 12 mm, was 4 kg. It should be noted, however, that this linothorax was designed to fit a 183-cm tall, 90-kg person with a chest circumference of 107 cm (6 ft., 200 lb., 42-in. chest). The typical young adult male in ancient Greece would very likely have been considerably shorter and lighter. Studies suggest figures of 150–75 cm tall and 65–70 kg.[18] Therefore, our replica likely represents the upper end of the spectrum in terms of weight, both because it is the practical maximum in terms of thickness and because the average soldier would have been significantly smaller in stature. Accordingly, a typical weight for a linothorax in the ancient world was probably around 3.5 to 4 kg.[19]

How much an ancient bronze cuirass weighed is an issue that is much debated among scholars, with estimates ranging widely. The bronze cuirasses that do survive vary considerably in thickness and therefore in weight as well. Further complicating matters is the fact that bronze suffers corrosion over time, so it is not simply a matter of weighing the extant examples. The weight of several surviving bronze cuirasses is around 4 kg, but all of these are considerably lighter than they originally would have been because of missing sections and the effects of corrosion.[20] These examples also lack the necessary padding that would have been found on the interior of the armor, as well as the *pteruges* and other external fittings. Ancient literary sources rarely supply reliable weights for body armor. One possible citation is offered by Plutarch, who reports that two cuirasses given to Demetrios Poliorketes weighed 40 minas, which has been calculated to be roughly 14–18 kg (*Demetrios* 21.3–4).[21] In his reconstructions of a hoplite panoply, Hanson (1989, 78) estimates that a typical bronze cuirass of the bell type would have weighed almost exactly this figure, between 13.5 and 18 kg.[22] While this seems rather heavy, it does accord

with Plutarch as well as with the frequent complaints in ancient literature about the onerous weight of bronze armor.

An alternative way of estimating the weight of bronze armor is to calculate the weight of a bronze cuirass of a given thickness. As discussed in the chapter on test results, the two main sections of a bronze cuirass, the chest and back plates, seem to have varied between 1 and 2 mm thick. Using these figures, it is possible to calculate a weight range of 4 to 8 kg. To this must be added the weight of a cloth or leather lining and the *pteruges*, which also may have had bronze plates or fittings. These elements probably added another 1–2 kg of weight. Thus, a likely total weight range for bronze cuirasses using this method was between 5 kg for one that was 1 mm thick and 10 kg for one that was 2 mm thick. Connolly estimates a weight of 6 kg for a bell cuirass, and Jarva offers a range from 4 kg for a 1-mm-thick bronze cuirass to 8 kg for a 2-mm-thick bronze cuirass, with a couple more kilograms of weight necessary to account for lining and *pteruges* in both cases.[23] Recently, Krentz (2010, 46, on the basis of statistics in Franz 2002) has argued for a lower range of bronze cuirass weights, suggesting an average of 4.8 kg, with a variation of from 3.5 to 5.6 kg.

All of this gives us a considerable range for the notional weight of bronze cuirasses, with a minimum weight of around 5 kg and upper estimates going as high as 18 kg. While no doubt there were instances of exceptionally heavy armor, we know that a bronze cuirass, to have constituted effective protection, would have to be made of metal between 1.5 and 2 mm thick and would have weighed in the range of 8 to 11 kg.[24] As our arrow tests showed, the protective capability of a 12-mm-thick linothorax was roughly equivalent to 2-mm-thick bronze plate. In other words, a 3.5- to 4-kg linothorax seems to have offered about the same protection as an 8- to 11-kg bronze cuirass. Thus, switching from a bronze to a linen cuirass could potentially have resulted in a weight reduction of 4 to 7 kg, with a commensurate increase in mobility and endurance. The gains in these areas would have been even greater if the comparative coolness, flexibility, and comfort of the linothorax were also factored in.[25]

Naturally, body armor was but one element of the burden that an ancient hoplite had to bear. To this must potentially be added the weight of shield, helmet, spear, sword and scabbard, greaves, and other possible pieces of equipment, such as arm guards, thigh guards, belts, shield skirts, and footwear. Estimates for the total weight of a full hoplite panoply (including bronze cuirass) in various time periods vary enormously, from a minimum of around 15 kg to a maximum of 40 kg, but a reasonable guess for a typical weight might be around 20–25 kg.[26] When considered against the total weight carried by a hoplite, even a reduction of 4–7 kg as the result of switching from a bronze to a linen cuirass would be significant. In this context,

the general fifth-century B.C. shift away from the bell cuirass toward lighter forms of body armor, including Type IV variants, is understandable.

The increased flexibility, coolness, and lighter weight of linen armor could have opened up tactical possibilities not previously available to more heavily burdened hoplites. The famous running charge of the Athenians at the Battle of Marathon may be an example of such a maneuver. Herodotus explicitly and repeatedly claims that the Athenian phalanx ran approximately a mile to engage the Persians (6.112.1–3), a statement that has been greeted with skepticism by many scholars and which has spawned heated debates about the weight of hoplite panoplies, the range of Persian bows, and other related topics.[27] Along with many others, we believe it highly unlikely that the Athenians could have covered this distance running at high speed; more likely, they advanced at a jog, and then, perhaps, sprinted the final stretch. Even this would have been an impressive athletic feat, but it would be considerably more believable (and possible) if the majority of the soldiers were equipped with lighter forms of body armor such as the linothorax rather than the old-style bronze cuirasses.[28] If Alexander's army was primarily equipped with cool and light linothorakes, it could perhaps be a minor contributory factor in explaining how he and his army were able to march so far, so fast, and in such sweltering climates.[29]

Perhaps the category of assessment in which the linothorax is most impressive is its wearability. It is a highly durable type of armor that can withstand hard usage in the field and in battle without losing its basic functionality. Simple methods can be employed to render it waterproof or water-resistant and, even when constructed in its most vulnerable form using water-soluble glues, it can stand up to repeated soakings. During day-to-day wear or in battle, it can suffer bending, perforations, cuts, and abrasions, yet such damage can be quickly and cheaply repaired by individual soldiers without recourse to specialized skills or tools. It is easy both to store and to transport.

Owing to its inherent flexibility, it is unusually comfortable and can be readily adjusted to fit different body sizes and shapes. It allows the wearer a considerable range of motion and does not impede any military actions, so that it would have been appropriate for use by almost any category of ancient soldier. Particularly advantageous is its comparatively light weight, which increases both the mobility and the stamina of the wearer. It exploits the natural breathable qualities of linen and is less absorbent of heat than any other comparable variety of armor, making it perhaps the best suited of all types of body armor for sunny and hot climates. Finally, by keeping its wearer relatively cool, it also improves his endurance, whether on the march or in battle. For all of these reasons, it is a form of armor well adapted to the agrarian societies and Mediterranean climate in which it flourished.

Economic and Social Considerations

The basic materials and skills needed to make a linothorax would have been almost universally available around the ancient Mediterranean, suggesting that almost anyone could have constructed a reasonably effective specimen of body armor. One factor potentially limiting such production, however, would have been the labor necessary to manufacture the requisite amounts of fabric. Some basic calculations can provide at least a crude estimate of how much work would have gone into producing a single linothorax.

Labor Required to Construct a Linothorax

First of all, it is necessary to consider how much linen was required for one corselet. All of our reconstructions were for individuals who, in the ancient world, likely would have been unusually tall, heavy, or both, so it is necessary to scale down our pattern accordingly. The estimated average dimensions of an athletic ancient Greek young adult male were 160–70 cm in height, 65–70 kg in weight, and with a chest circumference of up to 92 cm (5'3"–5'7", 143–54 lb., 36-in. chest).[1] In our testing, we determined that an optimal thickness for a linothorax was about 12 mm, and to reach this thickness using our most authentic linen required at least 10 layers. This particular fabric had a density of nine threads per 1 cm, and the yarn used had a weight of 500 g per 2,400 m of thread. In addition to the amount of fabric required to cut out 10 iterations of the basic torso and shoulder pieces, more linen would also have been needed for the *pteruges*. We decided to give our notional linothorax an overlapping double row of *pteruges* with each individual flap made from four layers of linen and measuring 20 cm in length. Altogether, such a linothorax would demand about 65,000 cm^2 of linen. Arranging the components in the most efficient manner possible, we calculated that a piece of linen 1.4 m wide and 4.5 m long would be required to construct a single linothorax of these dimensions.

Next we have to calculate how much thread would be consumed weaving this piece of fabric.[2] One problem is that a loom 4.5 m long was unlikely to have been a practicable piece of equipment in a typical household.[3] One of half this length (2.25 m) would be more reasonable, however, and is in accordance with some vase

paintings depicting weaving.[4] Therefore, for our computations, we assumed that the necessary linen could be produced by setting up two looms (or the same loom twice) and weaving two pieces of fabric, each measuring 1.4 by 2.25 m. To end up with a finished piece of fabric that is 1.4 by 2.25 m, however, some allowance has to be made for shrinkage and for the extra thread consumed in setting up the warp. Thus, we need to assume a warp height of 1.55 m and width of 2.35 m. With a thread count of nine threads per 1 cm, weaving each 1.4 by 2.25 m piece of cloth would require about 3,300 m of thread for the warp and about 3,000 m of thread for the weft. Adding these together and repeating the whole procedure for the second piece of cloth yields a total amount of around 12,600 m of thread for one linothorax.

We now have a sense of the amount of cloth and thread that went into one linothorax, but another important factor to consider is the hours of labor that would be needed to transform the raw materials into a linen corselet. A huge variable in such a calculation is the skill of the spinner(s) and weaver(s) doing the work. Given that many (perhaps most?) women and girls in the ancient world spent hours every day spinning and/or weaving, we can probably assume a fairly high level of proficiency. Information from modern weavers who work using traditional methods and tools suggests that a skilled ancient weaver (or, more likely, several weavers cooperating) could probably have woven our notional 1.4-by-2.25-m piece of cloth in about 20 hours.[5] Before the actual weaving could begin, however, the loom would have required considerable setup time to create the warp and attach all the threads to the loom frame and the loom weights. For a loom of this size, the setup time would perhaps have been around 15 hours of labor. Thus, for the weaving stage, each piece of cloth would have required at least 35 hours of work. Multiplied by two and with more time added for starts and stops and dealing with such things as broken threads and mistakes, a total weaving time of around 75 hours is a reasonable guess.

The most time-consuming aspect of the whole endeavor would not have been weaving, however, but spinning. Creating long, usable lengths of thread by twisting together individual flax fibers through the process of spinning was a highly skilled yet tedious operation. This was particularly true in the ancient world, when spinning was performed with a hand-held spindle.[6] If we assume that the spinners were fairly skilled, producing the necessary 12,600 m of thread of the specified weight using a spindle could have been accomplished with around 575 hours of labor. We can further calculate that to spin this amount of thread would have required roughly 3 kg of hackled flax fibers. Moving yet further backward in the production sequence, to end up with 3 kg of ready-to-spin fibers would have taken about 25 man-hours' (or woman-hours') worth of breaking, scutching, and hackling.

This is about as far as one can take such labor calculations with any degree of certainty. The very earliest steps in the production process would have been the actual planting, harvesting, and retting of the flax plants. It is much harder to estimate labor times for these activities because they would have been occurring sporadically throughout the year, could vary greatly according to environmental conditions, required less skilled labor, and constituted part of the general background of rural activities. Therefore, for the sake of coming up with a reasonably accurate time estimate, we will omit them from our calculations. Thus, the estimated time to produce the cloth for one linothorax of a size for a typical ancient Greek warrior is 25 hours to produce the hackled flax fibers, 575 hours to spin the fiber into thread, and 75 hours of loom setup and weaving, for a grand total of about 675 hours of skilled labor.

The other raw material is the glue. When manufacturing rabbit skin glue (or any hide-based glue), the goal is to extract the collagen from the skin and store it in a dried form. It can then be employed whenever needed as a glue by simply adding water and heating it. After one has caught and skinned some rabbits, the necessary steps consist of soaking the hide (sometimes for up to a month) in lime in order to break down the collagen, followed by rinsing the mixture with a weak acid to neutralize it. Then heat is applied, and the collagen coagulates out as small nodules. Repeated heatings produce collagen nuggets of steadily decreasing strength as a fixative. The collagen can be dried and stored in this form, or it can be ground into an even more easy-to-use powder. When one wants to make up a batch of glue, the nuggets or powder are hydrated in a pot of water and heated, with a ratio of about 80 g of rabbit glue powder per 1 l of water. Once it reaches a viscous consistency, it is then ready to be applied.

When constructing a linothorax, we found it desirable to completely saturate the fabric with glue, so a large volume of glue was required. Some of our bigger linothorakes consumed up to 7 l of prepared glue. For the ancient Greek-sized linothorax, probably about 5 l of liquid glue (made from c. 400 g of rabbit glue powder) would have been needed. How many hours would have been needed to produce 400 g of ready-to-use rabbit glue powder is difficult to estimate, because much of the preparation process is passive and consists of waiting for various chemical reactions to occur. We can guess that this would ultimately have amounted to at least 8–10 hours of direct human labor.

The next calculation is the labor to convert the raw materials of linen and glue into armor. Measuring and cutting out the roughly 100 separate pieces of cloth for the armor and *pteruges* took about 8 hours. The gluing has to be done in 10 separate stages because each layer needs to be allowed to dry completely before the

next is added, and so 10 batches of glue also have to be prepared separately. The gluing process itself, however, is relatively fast. Allotting roughly 35 minutes for each iteration, the total labor for the gluing stage would be about 6 hours. The *pteruges* could be fabricated during four of these gluing episodes, adding a total of 5 more hours. The assembly of the components, boring holes for ties, and affixing fittings took about 10 hours. The final stage, painting and decoration, could obviously vary enormously depending on the elaborateness of the desired ornamentation. Few linothorakes had no decoration whatsoever, and while one could spend hours on an intricate design scheme, painting a star or two and giving the corselet a couple of basic ornamental touches, such as stripes on the *pteruges* or outlining the shoulder flaps, could be done in an hour. Thus, the minimum total number of hours of labor required to construct one linothorax from the basic components would be approximately 30 hours.[7] When all the steps of producing the materials and assembling a linothorax are combined, the estimated grand total is 715 hours of labor.

The Cost of Linen Armor

At first glance, this estimate of 715 hours of labor to make a linothorax seems to amount to a lot of work, but if one had the necessary components of cloth and glue on hand, turning these into a viable piece of armor could have been done quite rapidly and with a minimal level of skill. It is clearly one of the advantages of the linothorax that, if one suddenly needed armor, it could be produced out of materials that were probably already present in the form of existing clothing, tarps, curtains, or blankets and commonly available glue and without the assistance of a skilled craftsperson such as a blacksmith. The test results revealed that there is no particular advantage to using fine or expensive linen with a high thread count rather than coarser cloth, so a linothorax could be created from the cheapest available linen. While we cut out our pieces from large sheets of fabric (and it would be desirable to cut the innermost and outermost layers out of single large pieces of cloth), this uniformity is not necessary for the intervening layers, and one could combine smaller pieces of fabric in order to form each layer. Because the glue conveniently bonds the whole thing together into a single, solid slab, a linothorax could in theory be cobbled together largely out of whatever scraps, rags, and odds and ends of fabric happened to be available.[8] Wealthy or high-status individuals might well have chosen to have their corselets made out of uniform, high-quality fabric as a status statement, but in functional terms this would be unnecessary, and the protective qualities of a linothorax made of scraps would be little different from those made of the finest linen.

This flexibility of construction complicates any attempt to calculate the cost of a linothorax. On the one hand, the amount of labor seems very considerable: an estimated 715 hours of labor. On the other hand, over 91% of this time (650 hours) is represented by just the two stages of spinning and weaving, work undoubtedly being performed incessantly by the female members of many households. The fact that so much of the labor that went into a linothorax was probably done by women as part of their everyday household duties makes it a highly unusual piece of military equipment, and further complicates estimating its cost. This factor makes it unlike nearly every other weapon or piece of armor, all of which would have been constructed or forged by highly specialized male craftsmen using rare, expensive materials.

If a linothorax were assembled out of scrap or recycled fabric, then the hypothetical "cost" of making one could be negligible or even zero, because, in certain cases, no extra or special materials would need to be purchased, and most of the labor would simply be absorbed into the constant cloth production that was a perpetual background activity of the household. Just as poorer families probably did not set aside money in their budget to purchase clothing because it was simply expected that members of the household would produce the clothing themselves, a household potentially could plan on manufacturing the body armor of its menfolk in a similar fashion.

While all the spinning and weaving that went on in a typical household certainly constitute economic activity, unless fabric is being produced for sale to others, such activity is not really part of the cash economy. It is instead closer to the original Greek sense of the word economy, meaning what went on as a matter of self-provision within the *oikos* (household). Particularly for hoplites edging toward the lower end of the economic spectrum, the possibility of manufacturing your own body armor entirely "in house," without any actual expenditure of coinage, would have been appealing.[9] All of one's cash could then have been applied toward the necessary military equipment that could not be as readily self-produced, such as spear, sword, helmet, and shield.

Cost and Availability of Leather versus Linen

Another possibility, particularly for less affluent warriors, was to fashion body armor out of animal hides, and, as has been discussed in detail in chapter 3, it is likely that at least some Type IV corselets were indeed made out of leather. This option has often been championed by scholars because of two basic assumptions regarding these materials: that leather was more widely available than linen, and that leather

was cheaper than linen. These assumptions seem traceable back to a sentence in Anderson's (1970, 23) study of Greek warfare, in which he states, "in Greece, leather must have been more generally available than linen." Although he does not offer any evidence whatsoever for this statement, it unfortunately has been generally accepted by later scholars, who have gone on to build their own conclusions based on this fundamental "fact." For example, Schwartz (2009, 70) comments that "it has been plausibly suggested that leather was a rather more accessible commodity than linen in Greece"; Everson (2004, 152) notes, "I have mentioned the increasing use of leather for these corselets which Anderson suggests happened because it was a cheaper alternative to linen and more easily accessible"; and Jarva (1995, 146) states that "it will suffice to note here that ox hides were no doubt much cheaper than linen."[10] Because arguments favoring leather are usually based on these assumptions, it is worth examining their validity in greater detail.

It is not at all clear that, particularly for poorer hoplites, appropriate animal hides would have been cheaper or more readily available than linen. Making a corselet of the Type IV pattern using animal hide would require a very large, thick, and continuous sheet of hide from a sizable bovid such as an ox. While such a hide may not have been extravagantly expensive to purchase, it is unlikely to have been an item that the typical family farm would have had on hand. In Greece, large ungulates were fairly expensive and relatively rare creatures, and most small farms would probably not have possessed a pair of oxen. Even if they did, it is unlikely that they would have been willing to kill one in order to obtain its hide, at least not until its days plowing or pulling a cart were over.

Calculating costs for ancient commodities is notoriously unreliable, but some sense of relative values can be gleaned from the prices Solon supposedly set for various items. A *medimnos* of grain (c. 52 l or 42 kg) was valued at 1 drachma and an ox at 5 drachmae (Plutarch, *Solon* 23.3). Accordingly, an ox would have been equivalent in value to about 260 l (or 210 kg) of grain, and this in turn was roughly the amount necessary to support one person (on a very monotonous diet) for a year. Even after killing the animal and removing the hide, one would have had to treat or tan it using one of several methods before it could have been made into armor—a process that can take up to a year.[11] Certainly it is possible that one might have had a suitable large, processed hide stored up and ready for use, or that such an item could have been purchased, but either of these options would represent more of a deliberate investment than a linothorax made out of scraps and old or unwanted items of fabric.

There is one ancient source that perhaps allows a direct price comparison of the raw materials needed to make a leather corselet versus a linen one. This is Diocle-

tian's Price Edict of A.D. 301, which includes specific maximum prices for a wide variety of fabrics and hides. In Diocletian's Edict, a good-quality tanned oxhide appropriate for use in making the soles of shoes is valued at 750 denarii (8.7).[12] In the same document, a Roman pound of low-quality, coarse linen yarn has a price of 72 denarii (26.12), and approximately 9 of these Roman pounds would be equivalent to the 3 kg of coarse linen thread needed to construct our "typical" linothorax.[13] Therefore, the cost of the yarn needed to make the linothorax would have been 648 denarii. If one had to pay a weaver to transform the thread into cloth, the listed per-day rate for a second-quality linen weaver is 20 denarii, and using our estimate of 75 hours of weaving, this would translate into about 8 days of labor, for an additional 160 denarii. Thus, the total price for buying the raw materials for a linothorax in A.D. 300 would have been around 800 denarii.

Jarva (1995, 37) assumes that two leather corselets could be made from one oxhide, but given the generally smaller size of domesticated animals in the ancient world and the fact that oxhides vary considerably in thickness over different parts of the animal (and one would presumably have wanted to use just the consistently thicker portions for armor), this supposition might be optimistic. A safer assumption might be that one good corselet could be obtained per hide, cutting it out from the thickest, most uniform leather, which is found only on the back of the animal. This would have left some excess material that could then have been employed for other purposes or else sold. On the basis of Diocletian's Edict, therefore, the price for the basic materials to make a leather corselet would have been 750 denarii, versus 800 for a linen one.[14]

While one would like to place faith in the accuracy of these numbers, the specific historical circumstances of Diocletian's Edict and the awkward fact that it dates from an era at least 400–500 years later than when the Type IV corselet was prominent, make using these figures a highly speculative enterprise. Attempting to convert them into equivalent values for Archaic, Classical, or Hellenistic Greece in order to compare them to known prices for weapons or armor seems even more tenuous. The most that can be safely concluded is that, if one had to buy them on the open market, the raw materials for a linen corselet were roughly equivalent in price to those for a leather one, or at the very least they were of the same order of magnitude.[15] Additionally, the potential difficulties of obtaining and working with leather make home production of leather corselets less likely than home production of linen-based armor.

The converse of the supposed greater availability of leather is the assumption that linen was relatively rare and, when available, expensive. To some degree, this seems to stem from a perception that linen was not widely produced in Greece and

had to be imported from places such as Egypt. While ancient sources do emphasize that Egypt had a tradition of making very high-quality linen and that such fabric was viewed as a luxury good in ancient Greece, it is clear that linen (though perhaps of lesser quality) was widely produced not only throughout Greece but in nearly every region around the Mediterranean.[16]

A complicating factor in determining the range of linen production is distinguishing sites where linen was being woven or flax being spun from those of wool manufacture. Often any place where loom weights are found is identified as a site of "wool production," but in the absence of other information (such as sheep bones), these could just as easily be evidence for linen production. Although pursuing this line of argument is beyond the scope of this book, one is tempted to suggest a possible gender bias in the way that evidence for early textile production has been interpreted by (overwhelmingly male) archaeologists, who seem to express a consistent preference in favor of wool over linen. Could this perhaps be because, in at least a few early stages of wool production, men played prominent roles (e.g., as shepherds), thus fulfilling a traditional male identity as the "tamers" of beasts, whereas linen production can take place nearly entirely within the female sphere? Barber (1991, 10–11) offers an enlightening example involving one of the oldest extant scraps of fabric, which excavators doggedly persisted in identifying as a piece of wool in the face of steadily mounting evidence that it was actually linen, until scientific tests finally and irrefutably proved that it was indeed linen. In reality, both fabrics were probably being produced in varying qualities and quantities almost everywhere by the time period with which we are concerned.

Even if linen was a standard textile being widely produced in private households, uncertainty remains as to how many people were actively engaged in weaving. Probably most independent farming households and country villas had at least some women working at textile production, but the picture is less clear for urban households. Spinning could be done almost anywhere, even while walking or performing other tasks, and a spindle could easily be fashioned out of the most rudimentary materials. This is one reason why spinning was sometimes viewed as a profession appropriate for those who had fallen on hard times or who had few resources, because so little was required in terms of capital investment in order to pursue it.

Weaving was a different matter. While the basic physical components utilized in weaving were again fairly cheap—wood for the loom frame and some terracotta or stone weights—the loom itself was a rather large and immobile object that had to remain in place for extended periods of time while in use. The motions of weaving necessitated a certain degree of access to both sides of the loom, and thus, in

addition to the space occupied by the loom, its use required a clear zone all around it. When not in use, it could be taken apart and stored much more compactly, but once a piece of fabric had been begun, the loom had to stay assembled until it was completed. Weaving additionally demanded an area sheltered from the elements but that still had good lighting. Thus, a fair amount of space of a particular type was needed in order to engage in weaving—something that might not be available, for example, in an urban apartment.

As weaving in a domestic context is usually seen as a female-gendered activity, it is necessary to consider where it might have occurred.[17] The stereotyped view of the gender divisions of space in the Greek house is expressed in a speech by Lysias, in which the sexes are portrayed as occupying separate portions of the household, with the women's quarters on the upper floors of the house, while the men's were on the ground floor (Lysias 1.9).[18] Confirming this supposed division via archaeological evidence is complicated by the problem that, in most excavated Greek houses, only the ground floor remains and the upper story (or stories) is completely missing. The rigidity of this scheme has been challenged by recent scholarship, and the gender division of Greek houses now seems to be a rather more complicated issue.[19]

Archaeological evidence can perhaps offer a more detailed image of ancient urban domestic weaving. At Olynthus, for example, of roughly 100 excavated houses for which records were kept of the assemblages of artifacts found in them, about one-third (35) show evidence of active weaving in the form of grouped deposits of loom weights sufficient in number to have equipped at least one loom.[20] Interestingly, weaving seems to have occurred in almost every area of these houses with the exceptions of the *andron*, bathroom, and entrance hall. The most common spaces where looms seem to have been set up were enclosed or semi-enclosed rooms adjacent to the central, light-providing courtyard. Eight of these houses had more than one room in which weaving took place, and four seem to have been sites of large-scale textile manufacturing. Finding loom weights in these homes does not prove that weaving was occurring in them continuously, nor does the lack of explicit archaeological evidence for weaving in the other houses at Olynthus mean that weaving never happened there. It does, however, support the idea that at least a sizable percentage of Greek households, even urban ones, had the potential to produce linen armor.[21]

Therefore, to the question of how much a no-frills, functional linothorax would have cost in ancient Greece, there are really two answers. If you (or your household) were already engaged in linen production, the cost could be close to zero; but if you bought linen on the open market, it would have represented a substantial

though not an outrageous investment and was probably comparable in cost to the materials needed to make a leather corselet, the other main alternative to bronze armor. Many poorer hoplites, as well as the numerous more lightly armed soldiers who accompanied a Greek phalanx, would probably have been drawn to forms of linen or leather armor for reasons of economy and potential ease of manufacture.

Given that linen armor was cheaper, in some ways more practical, and certainly more versatile than bronze armor, a natural question that arises is why any soldier persisted in wearing metal armor. Factors that might help to explain this, as is so often the case in the ancient world, may have as much (or more) to do with status than with strict economic rationality or even practicality. First, bronze was the traditional and time-honored material associated with armor, going all the way back to the heroic role models in Homer. Second, there was one very pragmatic consideration in its favor—bronze armor could always be made thicker to enhance its protective ability, whereas laminated linen corselets seem to have had a functional upper thickness of about 15 mm before they began to crack or delaminate when repeatedly bent. In terms of defensive ability, if you were willing to endure the weight, a bronze cuirass of greater than 2-mm thickness would have represented the best available form of armor. You would not have been very mobile, but if you were determined to have the absolute maximum possible protection and possessed the wealth to indulge in any option, you might well have selected a bronze cuirass. Thus, there would always have been a demand for heavy metal armor from those whose overriding concern was protection.

The third (and probably more influential) reason is that bronze armor would have very publicly made the statement that you could afford the materials and the fees for the specialized craftsmen necessary to produce it. Furthermore, such armor would have had the cachet that it was custom-made and individually fitted just for you—another indication of one's wealth and elite status. Thus, a strong appeal of bronze was the very fact that it was expensive, and those who wished to ostentatiously display their wealth to their peers might well have chosen it in order to proclaim and assert their economic status. In societies such as Athens where citizens were formally divided up and categorized by wealth, for the richer classes there would have been pressure to present a visible image that was in accordance with one's economic standing. A hoplite from the upper economic classes might not have wanted to risk being mistaken for one of a lower class by wearing the sort of armor that a poorer man could typically afford.[22] When a phalanx composed of citizen militia mustered together, there was clearly a fairly broad spectrum of economic classes represented. This intermingling of rich and poor was commented

upon by authors such as Plato, who contrasts a poor but robust farmer with a rich but out-of-shape aristocrat serving side by side in the phalanx (*Republic* 556ce). One obvious way to differentiate yourself in such a situation, and to assert your status, was by the expense of your arms and armor.[23]

Finally, bronze is, quite simply, shiny and impressive looking. As van Wees points out, the thin bronze facings applied to a shield added little or nothing to its protective value, but they made the shield look much more formidable.[24] Xenophon admits that the main advantage of a bronze-plated shield was that it could be polished so that it would shine brightly (*Spartan Constitution* 11.3). Bronze armor was desirable because it was, both literally and figuratively, flashy. In addition to being ostentatious, reflective armor may have had a practical purpose in making one look more impressive, and thus intimidating or even distracting one's foes on the battlefield. The continuing appeal of bronze can readily be explained by a combination of tradition and the facts that bronze looked warlike and impressive, the very best available protection was thick bronze, and metal armor both carried connotations of elite social and economic status and proclaimed that status in a very public and visible way.

Large-Scale Production

Thus far, the discussion has focused on typical militia-type soldiers who would have been expected to provide their own arms and armor, and on the limited resources that they might have had available to them to produce their panoply. What about wealthy individuals who might have been more likely to purchase their equipment immediately using cash rather than produce it partially or fully themselves? Related to this is the question of how states such as Macedon, which apparently supplied equipment to its soldiers in a systematic way, obtained large quantities of weapons and armor.[25] Were there workshops mass-producing linen corselets, and if there were, did they also make the linen (and even possibly the thread) themselves, or did they purchase premade cloth and just do the assembly? How much would a corselet from such a workshop have cost?

There is some evidence for large-scale private manufacturers of arms and armor. In the late fifth century B.C., Cephalus, the father of Lysias, operated a shield factory at Athens that employed 120 slaves, and at times maintained as many as 700 shields in stock (Lysias, *Against Eratosthenes* 12.19). The father of the orator Demosthenes (also named Demosthenes) was another such arms merchant, running a sword factory with 32 or 33 slave workers (Demosthenes, *Against Aphobus* 27.9; cf.

Plutarch, *Demosthenes* 4). Other sources mention piles of weapons and armor made by specialists in each type readily available for sale in the public marketplaces of Greek cities.[26] In Sophocles' *Epigonoi*, when preparations for war are being described, there is the line, "and for the wearers of breastplates the weavers are striking up the wise shuttle's songs."[27] This ancient source explicitly cites weavers as being among the groups of craftspeople called upon to aid in the production of military equipment. Whether these weavers are male or female, free or slave, is not specified. Nevertheless, it seems reasonable to assume that there was a market in high-quality linen corselets being produced by manufacturers for sale to individuals seeking such armor.

When this market is expanded to include the equipment needs of entire states, the scale of necessary production begins to grow quite large. For example, in 326 B.C., Alexander ordered 25,000 corselets to be sent to him in India to replace the ones that had worn out during the march (Quintus Curtius Rufus 9.3.21). When Alexander's troops mutinied at the Hyphasis just before his request for new corselets, one of their grievances was that they had been fighting for so long that their "armor was worn-out."[28] While the description of the new armor (which is particularly ornate, with decorative metal fittings) is ambiguous in regard to what it is made of, the fact that Alexander then orders the old armor to be burned indicates that the original corselets were made of an organic material that was combustible, and therefore most likely either leather or linen.[29] If they were linen, and we multiply 25,000 by our notional construction time of 715 hours per corselet, then initially equipping part of Alexander's army with body armor would have required 17,875,000 hours of labor, or, to put it another way, a force of 3,000 workers would have had to work 8 hours per day, every day, for just over 2 years to produce the necessary corselets.[30] How a state such as Macedon went about procuring very large orders of military equipment, and whether these orders were contracted out to private suppliers, or whether state-owned and state-run "factories" were established, remains undetermined. What is certain is that producing such equipment required a great deal of labor and that the "armaments industry" of the ancient world may have constituted (at least at certain times) an underappreciated component of the ancient economy.

Gender Issues

There were undoubtedly some male weavers in the ancient world, and they may have played a role in producing the linen used for armor.[31] Because women made the majority of textiles, however, it also seems likely that most of the fabric that

went into linen armor would have been woven by women. This runs contrary to the strong trend that nearly every other piece of equipment employed in warfare was crafted by men. Clearly there were powerful and deeply ingrained mores about appropriate realms of male and female activity, and one of the strongest of these was that war was an exclusively male domain. This raises the question of whether there might have been a reluctance to use armor whose constituent materials had been made by women. A similar unwillingness to acknowledge substantial female contributions to a male realm of activity might have made ancient sources circumspect about recognizing or even mentioning the role of women in producing armor.

On the other hand, in connection with women's potential involvement in the fabrication of military equipment through textile production, we might consider the strong tradition in ancient Greece of girls and women performing sacred weaving at temples and sanctuaries. The most famous example of such sacred weaving is the Athenian ritual in which looms were set up on the Acropolis and young girls were chosen from noble families to weave the *peplos* that would be placed on the cult statue of Athena Polias during the Panathenaia festival nine months later. The weaving was supervised by the priestess of Athena Polias, and adult women and possibly the girls' mothers may also have participated in the weaving.[32] While this is the most famous example of women going to a sacred site to weave a garment for a cult statue, it is by no means the only one. Every four years at Elis, a select group of "the best" 16 women would congregate in a specially designated structure in the agora in order to weave a new robe for the statue of the goddess Hera (Pausanias 5.16.2; 5.16.5; 6.16.2).[33] At Amyklai, a group of women had to gather every year to weave a tunic for the colossal cult statue of Apollo (Pausanias 3.16.2). Other examples of cult statues being dressed in garments include Artemis at Brauron, Hera at Samos, Leto at Delos, Hera at Olympia, Artemis at Ephesus, Hera at Delos, Demeter and Kore at Delos, Poseidon at Elis, and Asklepios at Titane.[34] Similar traditions go far back in Greek history, with Hecuba described as offering a robe to Athena in the *Iliad* (Homer, *Iliad* 5.87; 6.301), and Spartan women recorded as ritually presenting a robe to Orthia at least as early as the seventh century B.C. (Alkman, *Partheneion* I, 60ff.).

In addition to woven garments used to clothe cult statues, temple inventories list vast quantities of woven goods dedicated by women as personal offerings to the deity.[35] These offerings range from textiles that are clearly valuable for the quality of their weaving or the cost of their materials to old, frayed, and incomplete items that were likely chosen by the dedicator for donation because of some special personal resonance. Not infrequently, the name of the donor is woven into the garment itself. Dedications at these temples also included the tools that women

used to make the textiles, such as spindles, spindle whorls, and loom weights. All of these items demonstrate that there was a close link between women's daily spinning and weaving and the ways in which women interacted (or were allowed to interact) with the divine. Textile production was not merely the primary occupation and duty of women, but their skill and devotion to it also constituted one of the principal ways by which their worth was judged and their status determined. It is not surprising, then, that it was through the medium of this primal female activity that women's interactions with the gods, whether via offerings or participation in rituals, often took place.

Might there have been a link between such ritual activities and women's role in producing the fabric for textile-based armor? If a woman were weaving linen that she knew was going to be used to make armor whose purpose was to preserve the life of her husband or son, it seems logical that she would have done at least a token amount of the weaving at a temple or sanctuary so as to hopefully imbue the armor itself with numinous protective qualities. During one of the many festivals or rituals in which sacred weaving was performed, might she not also have woven a bit of fabric intended for incorporation into armor being made in her household? When the everyday act of spinning or weaving was performed in a sacred space and/or during a sacred time, fabric became more than just cloth, and in this context may have been elevated to the status of a talisman bearing an extra degree of magical protection.

Another key aspect both of weaving and of these religious rituals was their communal nature. Weaving was an intensely social and group activity for the women of a household, and it is significant that all the sacred weaving rituals for which we possess sufficient details involved multiple women and/or girls collectively performing the weaving.[36] The shared nature of these activities made the final product representative of the community as a whole, and endowed it with the collective energy and prayers of the group while simultaneously serving as an offering on its behalf. Rituals such as the weaving of the *peplos* for Athena Polias would not have been nearly as potent if the garment had been created by a single woman. If we apply this same logic to cloth to be used in armor, producing some of the fabric at a sacred space and time along with a group of women performing the same act could have constituted another way of enhancing its potency.

One need not search hard to find cultural parallels from a range of societies of women weaving items thought to be imbued with numinous or magical properties that would offer some sort of extra protection to their menfolk in warfare, and

often these involve the collective action of many women in order to give these talismans extra potency. Such examples are by no means exclusive to premodern or preindustrial societies. For example, during World War II, it was commonplace for Japanese women to sew a *senninbari*, or "thousand-stitch belt," which was a band of fabric decorated with one thousand red stitches, each one sewn by a different woman. To obtain the requisite number of stitches, a wife, sister, or mother would stand in a public place, often outside a temple, and solicit passing women to each add one stitch to the belt. The belt was then given to a soldier or pilot who would wear it wrapped around his waist, or sometimes his head. These talismans were widely believed to safeguard the wearer from bullets or, at the very least, to bring him good fortune.[37] This example, drawn from a culture and era utterly different from ancient Greece, illustrates the universality of notions of the collective power of weaving women and their desire to use whatever skills they possess to protect their loved ones.

Admittedly, there is no concrete evidence that, as part of the many religious festivals focusing on women or entailing the production of sacred garments for

Fig. 8.1. Arming scene of warrior beginning to wrap Type IV corselet around himself, while a woman prepares to hand him the rest of his panoply. (R-184)

cult statues, women also created cloth intended for use in their men's armor, so this line of thought can only remain in the realm of speculation. Part of the problem, of course, is that the rites of many, if not most, religious festivals involving women were secret, and thus we know very little about what went on at religious sanctuaries during these occasions. The mysterious nature of female religious rituals (both to us and to the male authors who constitute our main source of information) easily leads to sometimes far-fetched conjecture. Given the primacy of spinning and weaving in women's lives in general, and the fact that weaving features so prominently in the little that we do know about women's cult activities, it does not seem unreasonable to speculate that there were other contexts for such sacred spinning and weaving.

What does suggestively survive, however, are the stock scenes appearing on many vase paintings of a warrior leaving home to go off to war. In such scenes, the warrior is usually depicted in the process of arming for battle, putting on his greaves

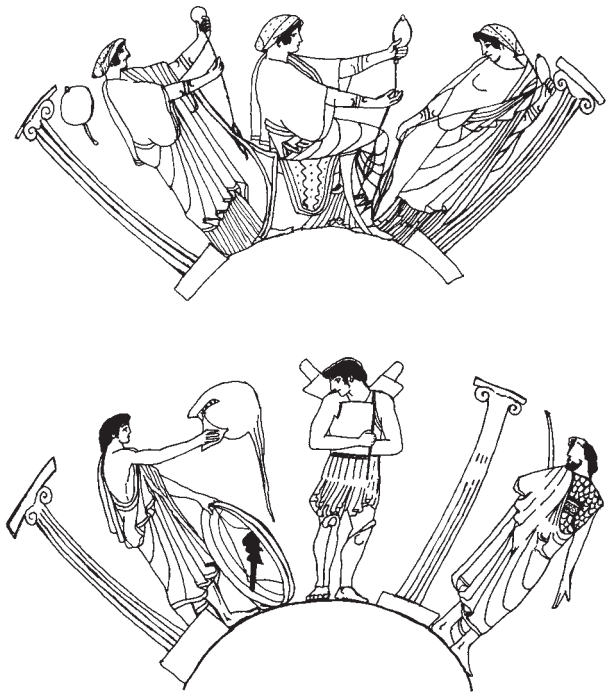

Fig. 8.2. Images from opposite sides of a red-figure cup, with two scenes set in the same, presumably domestic, setting—women spinning on one side and men arming on the other. (R-157)

or wrapping his corselet around his body (see, e.g., fig. 8.1). Inevitably, he is not shown alone, but rather is surrounded by the women of his household, who hold his arms and armor and hand each piece to him successively until he is attired in full military panoply.[38] With the threat of imminent death in battle looming, these are emotionally charged images, capturing perhaps the last moments that the members of the family will spend together. Yet there is an extra layer of poignancy if we consider that the armor that the wife gives to her husband or a mother to her son (and upon which the man's life will soon depend) might be the product of her own hands.

One remarkable red-figure cup attributed to the Oedipus Painter combines all these themes (fig. 8.2).[39] On one side is depicted a scene of three women spinning, with two standing female figures flanking a central seated matron. That this seems to be a domestic indoor setting is indicated by two Ionic columns on either side of the spinning women. The other side of the cup apparently shows the same indoor space because the same columns are again present on each side. This time, however, the area between them is occupied by a warrior arming for combat in the process of wrapping a corselet around his torso and with his untied shoulder flaps standing upright. A youth stands to the side holding the warrior's shield and helmet. The cup thus shows the male and female members of a single household engaged in stereotypically male and female activities—spinning and preparing for warfare—but it also perhaps invites us to make the connection between the women's industry and the man's armor.

Conclusion

With this book we have attempted to tackle a number of contentious issues, nearly all of which result from a lack of definitive surviving evidence. Scattered and incomplete literary sources offer enough mentions of linen armor that we can be sure that this item existed, but these same sources tantalize us by not providing adequate detail for us to know how it was made, exactly when it was used, and by whom. Similarly, the visual evidence is at the same time overwhelming in its volume yet frustrating in that it leaves many of the most basic questions, such as what material is being depicted, unanswered. One solution to such uncertainties is to simply throw up our hands and say, "Here is something about the ancient world that we will never have a definite answer to." Such a negative and passive reaction to the challenges posed by the surviving sources is as unhelpful as it is pointless. We must do the best we can with what we have, and when the meager evidence can be supplemented through the methods we have employed in this study, such as reconstructive archaeology, then these supplementary forms of information should be eagerly welcomed. While civilizations change over time, the basic laws of physics do not, and thus valid scientific testing can reveal information otherwise lost, and practical experimentation can produce valuable data, offer fresh perspectives, and yield new insights. Even if the conclusions resulting from such procedures must be accompanied by unattractive qualifiers such as "most likely" or "almost certainly," we have at least moved away from the realm of helpless ignorance and forward into one of calculated probabilities.

We have argued that armor made out of multiple layers of linen was widely used by many different ancient cultures (including the Greeks) across the Mediterranean for hundreds of years. The ancient literary sources testifying to this are simply too numerous and too explicit for any doubt to remain about this basic point. Whether the layers of these corselets were laminated together with glue or sewn together with thread cannot be determined with certainty. Given the widespread use of this armor and the lack of standardization in the ancient world, it seems safe to say that both methods were attempted. The laminated construction gives better protection and was easier to make; therefore, we suspect that it was the more common one.

Linen corselets can also with reasonable assurance be identified with the sort of body armor commonly seen in vase paintings and other visual images that has been labeled "Type IV" and is sometimes referred to as a "composite corselet," a "shoulder-piece corselet," or "tube and yoke armor." We have identified more than 900 of these images, which collectively provide useful information about how such armor was made, worn, and decorated. It is possible, however, to construct corselets with this same appearance out of materials other than linen, with the most likely alternative being leather. Although the textual evidence for such leather corselets is weaker, again, given the diversity of manufacturers and circumstances for making armor in the ancient world, it nevertheless seems highly likely that at least some of these images portray leather armor. In the surviving iconographic sources, armor made from the two materials would be indistinguishable.

When sifting through such issues, there often seems to be an odd desire to impose uniformity on the ancient world. Thus individuals will sometimes vehemently argue that all of the Type IV images on vase paintings must depict leather armor rather than linen, or that all linothorax images must represent sewn rather than laminated layers. Why we should assume such homogeneity across dozens of separate political units, spanning hundreds of years, in an era without standardized mass production, is inexplicable. Certainly such uniformity would make our modern analyses tidier, but the reality is that all of these materials and technologies were widely available in the ancient world, and all were likely employed by various warriors at one time or another. Whether an individual or group constructed armor using a specific technique or material at a given moment was determined by convenience, availability, necessity, and cultural traditions rather than for our convenience in forming typologies.

Our experiments and reconstructions have also revealed that linen body armor would definitely have enjoyed several distinct advantages over comparable bronze armor. First (and most obviously), it is simply a far more practical material to wear in a hot climate, which would have granted the soldier wearing it much greater endurance and mobility, both in battle and on the march. Metal armor heats up quickly, and under the glare of a hot sun quite literally bakes its wearer, whereas linen armor stays cool and comfortable. Second, the weight of the linothorax is considerably less than that of other common types of armor. A typical linothorax would have weighed around 3.5–4 kg. A bronze cuirass offering an equivalent degree of protection would have weighed in the 8- to 11-kg range. Thus, linen armor was roughly one-third the weight of bronze.

Other experiments demonstrate that the linen corselet would have been sufficiently sturdy to endure the rigors of campaigning and that it would have been

readily repairable. Depending on the materials used, it is either reasonably resistant to water or else can be given adequate waterproofing. One of the most attractive qualities of the linothorax is its potential to have been constructed extremely cheaply within an ancient household. Rather uniquely for a piece of military equipment, it employed materials that would have been widely available even to relatively poor individuals in the ancient world, and the technical skills needed to make a linothorax—spinning, weaving, and gluing—were common ones familiar to almost all inhabitants of the Mediterranean region. Most women in the ancient world would have been able to construct or repair one, so that the specialized skills of a blacksmith would not have been required as they were for almost all other arms and armor. Alternatively, the versatility of the basic design meant that very costly versions could be constructed employing high-grade fabrics and elaborate ornamentation.

Linen corselets would also have been suitable for mass-production since, unlike a bronze cuirass, a linothorax did not have to be made for a specific individual. Because of the ties at the side and top, a linothorax can easily be adjusted to achieve a perfect fit. Generically produced models were probably made in a few basic sizes, such as small, medium, and large, to match widely divergent body types, but then within these sizes, the fit of the linothorax could be fine-tuned using the ties.

Finally, and perhaps most importantly, the linothorax possesses all of these advantages while still providing excellent protection to its wearer, including, as we have demonstrated, against arrows. Thus, it was not merely a cheaper, inferior type of armor but a legitimate alternative to metal cuirasses. The gleaming, flashy appearance of bronze, its high material value, and its superficially impressive hardness ensured that the imposing metal-clad soldier has always remained the stereotypical image of an ancient warrior, but there is much to be said for the humble corselet made out of simple glue and cloth.

Plate 1. Three versions of reconstructed linothorakes. The one on the left is modeled after the linothorax worn by Alexander the Great in the "Alexander Mosaic" from Pompeii.

Plate 2. Detail of Alexander the Great from the "Alexander Mosaic" from the House of the Faun, Pompeii, thought to be a copy of a Hellenistic Greek painting. (P-10. Photo: Erich Lessing / Art Resource, NY. ART77502.)

Plate 3. Macedonian warriors on the "Alexander Sarcophagus" wearing Type IV armor that was brightly painted in yellow, purple, and red. (S-23. Photo: Erich Lessing / Art Resource, NY. ART53610.)

Plate 4. Painting of warrior fighting Amazons on the "Amazon Sarcophagus" from Tarquinia. He wears a white corselet edged with red. (P-3. Photo: Scala / Art Resource, NY. ART 74499.)

Plate 5. Name vase of the Achilles Painter. The armor is depicted as riding so high on his torso that his genitals are visible below the bottom edge of the pteruges. (R-182. Photo: Scala / Art Resource, NY. ART16624.)

Plate 6. First "authentic" reconstruction linothorax that we constructed, being worn by G. Aldrete. Note the belt, which we later omitted, and the lion's head fasteners.

Plate 7. Ballistics gel dummy surrounded by the authors. Clockwise from right, G. Aldrete, A. Aldrete, S. Bartell, and student volunteer, William Schwartz.

Plate 8. Photograph taken shortly after G. Aldrete shot S. Bartell with arrow from four meters' distance. In such shots, the arrows stuck in the armor dramatically, but failed to penetrate it.

Database of Visual Sources for Type IV Armor

For each image of Type IV armor, we have attempted to give a brief description of the image, the artist, the location where the object was found, the current location (including inventory number), an estimated date, at least one reference to a standard catalog system for this type of object (such as CVA for vases), and a reference to a well-known or standard work that contains a photograph or drawing of the object. Some citations are missing one or more of these elements, but we have tried to be as comprehensive as possible. ARV citations are from the second edition.

The images are organized into seven broad categories identifying the medium in which the image appears: Black-Figure Vase, Red-Figure Vase, White-Ground Technique Vase, Stone Sculpture, Terracotta Sculpture, Metal Objects, and Paintings. Within each category, the objects are listed chronologically, while acknowledging that many of the dates or date ranges are approximate or contested.

As a shorthand system for identifying key information, each entry begins with a code consisting of a letter and a number, a number in parentheses, and, for some entries, a notation in bold.

The initial letter represents the type of object according to the following scheme: B = Black-Figure Vase; R = Red-Figure Vase; W = White-Ground Technique Vase; S = Stone Sculpture; T = Terracotta Sculpture; M = Metal Object; P = Painting. The number that follows after a dash represents its place in the chronological sequence of objects of that type. Thus, for example, "R-1" would designate the earliest red-figure vase bearing an image of Type IV armor.

Next, the number in parentheses indicates the total number of images of Type IV armor appearing on that same object. If there is some evidence to suggest one or more additional examples of Type IV armor on the same object but the image is not clear or complete enough to make a definitive identification, then a plus sign (+) is added to the initial number.

Finally, for some entries, an additional notation in bold indicates the number of images on that object with the following specified attributes: the presence of **Scales** on the armor, a warrior on **Horseback** wearing the armor, a scene of a warrior **Arming** for battle involving a Type IV corselet, and a **Carried** Type IV corselet.

For example, consider an entry that begins: R-38 (4+) **1 Scale/Arming, 1 Horseback**. This indicates: that it is the 38th red-figure vase in chronological sequence; that there are a

total of four clearly visible images of Type IV armor on this vase; that there are additional images which look like Type IV armor but cannot be positively identified as such; that among the four clear images is one that has scales and is part of an arming scene involving putting on a Type IV corselet; and that among the four is another one that is worn by a person on horseback.

Black-Figure Vases

B-1 (1) Running warrior. Interior of Athenian black-figure Siana cup. The C-Painter (Grünhagen). c. 575–550 B.C. Mainz, Johannes Gutenberg Universität 89. CVA Deutschland 15 Mainz, Universität 1, pl. 42.1. CVA online vase #350151.

B-2 (1) Departure scene (warrior mounting chariot). Late Corinthian black-figure hydria. Cerveteri. c. 575–550 B.C. Paris, Musée du Louvre E642 (23695). Pl. 39.2 (no. 1447) in Payne (1971). CVA online vase #9019335.

B-3 (1) Departing warrior (or Ares?), accompanied by dog on chain, between Poseidon and goddess (Athena?). Athenian black-figure amphora (Type B). The Amasis Painter. Vulci. c. 575–525 B.C. Paris, Musée du Louvre F25 (MNB 1688). ABV 150, 4. CVA France 4 Paris, Musée du Louvre 3 (III.H.e), pls. 14.2, 16.4. CVA online vase #310431.

B-4 (1) Two fighting warriors. Athenian black-figure Siana cup. Lydos. Taranto. c. 575–525 B.C. Taranto, Museo Nazionale 20137. ABV 112, 65. CVA Italia 35 Taranto, Museo Nazionale 3 (III.H), pls. 22.2, 23.1. CVA online vase #310211.

B-5 (3) Amazonomachy. Athenian black-figure Droop cup. The Wraith Painter. Bologna. c. 575–525 B.C. Bologna, Museo Civico Archeologico GM6 (102). ABV 200, 10. CVA Italia 7 Bologna, Museo Civico 2 (III.H.e), pls. 30.1, 30.4. CVA online vase #302587.

B-6 (1) Warriors and youths. Athenian black-figure lekythos. The Wraith Painter. c. 575–525 B.C. Athens, National Museum 1072 (CC673). ABV 200, 3. CVA online vase #302580.

B-7 (1) Fighting warriors. Athenian black-figure Siana cup. Group of Acropolis 1441. c. 560 B.C. Basel, Antikenmuseum und Sammlung Ludwig BS1953.8. ABV 68, 1. CVA Schweiz 4 Basel, Antikenmuseum 1 (III.H), pls. 25.2, 25.4. CVA online vase #300617.

B-8 (3) Fighting warriors. Athenian black-figure Siana cup. The Heidelberg Painter. c. 560–550 B.C. Athens, National Museum 12667. ABV 65, 33. CVA Greece 3 Athens, National Museum 3, pls. 14.2A, 14.3A, 15.1A, 15.3B. CVA online vase #300577.

B-9 (2) **2 Scale.** Side A: Herakles and Apollo (wearing Type IV) struggling for tripod, with Hermes interceding. Side B: Achilles receiving armor from Thetis. Athenian ovoid black-figure neck-amphora. The Amasis Painter (signed). Orvieto. c. 560–525 B.C. Boston, Museum of Fine Arts 01.8027. ABV 152, 27. CVA USA 14 Boston, Museum of Fine Arts 1 (III.H), pl. 27.2. Fig. 86 in Boardman (1974). CVA online vase #310454.

B-10 (1) Battle scene with hoplites and horsemen. Athenian black-figure Little-Master band-cup. The Amasis Painter. Vulci. c. 560–520 B.C. Paris, Musée du Louvre F75. ABV 156, 81. CVA France 14 Paris, Musée du Louvre 9 (III.He), pls. 81.4, 81.7. Pl. 26.2 in Beazley (1964). CVA online vase #310510.

B-11 (15+) Combat of warriors. Athenian black-figure neck-amphora. The Amasis Painter (signed). Vulci. c. 560–520 B.C. Paris,

Bibliothèque Nationale, Cabinet des Médailles 222. ABV 152, 25. CVA France 7 Paris, Bibliothèque Nationale (Cabinet des Médailles) 1 (III.He), pls. 36.6, 37.3–5. Fig. 9B in Carpenter (1991). CVA online vase #310452.

B-12 (1) Warriors departing. Athenian ovoid black-figure neck-amphora. The Amasis Painter (signed). Orvieto. c. 560–520 B.C. Boston, Museum of Fine Arts 01.8026. ABV 152, 26. CVA USA 14 Museum of Fine Arts, Boston 1 (III.H), pl. 26.2. CVA online vase #310453.

B-13 (1) Fight, with warriors and horsemen. Athenian black-figure hydria (Chalkidian vase). The Painter of London B76. Cerveteri. c. 550 B.C. Cambridge, MA, Harvard University, Arthur M. Sackler Museum 60.318. (Formerly Oxford, MS, Robinson Collection). ABV 86, 4. CVA USA 4 Baltimore, Robinson Collection 1 (III.E), pl. 18.1. CVA online vase #300793.

B-14 (1+) Amazons arming. Athenian black-figure volute-krater. c. 550 B.C. Munich, Antikensammlungen 1740 (J538). Pl. 59.1 in von Bothmer (1957). CVA online vase #12917.

B-15 (2) Achilles and Ajax playing a game. Athenian black-figure belly amphora (Type A). Exekias, painter and potter (signed). Vulci. c. 550–530 B.C. Vatican City, Museo Gregoriano Etrusco Vaticano 344 (16757). ABV 145, 13. Fig. 100 in Boardman (1974). Pl. 62 and color pl. XII in Arias (1962). CVA online vase #310395.

B-16 (1) Battle scene from epic Aithiopios: Death of Achilles, and Ajax lifting his body. Athenian black-figure amphora (Type A). Exekias. Orvieto. c. 550–525 B.C. Philadelphia, University of Pennsylvania 3442. ABV 145, 14. Pl. 30 in Beazley (1964). CVA online vase #310396.

B-17 (1) Battle scene with chariots. Athenian black-figure Little-Master band-cup. Vulci. c. 550–525 B.C. Munich, Antikensammlungen 2240 (J881). CVA Deutschland 57 München, Antikensammlungen (ehemals Museum Antiker Kleinkunst) 11, pls. 56.1, 56.3–4. CVA online vase #31971.

B-18 (3+) **3 Scale.** Battle scene. Athenian black-figure skyphos. The Wraith Painter. c. 550–520 B.C. Athens, National Museum 18836. (Formerly in the Empedokles Collection, Athens E658). ABV 201, 18. CVA Greece 4 Athens, National Museum 4, pl. 16.1–2. CVA online vase #302595.

B-19 (2) Warrior carrying fallen comrade, and fighting warriors. Etruscan black-figure amphora (with separated neck). A painter of the Micali Group (CVA). c. 550–500 B.C. Milan, "H. A." C391. CVA Italia 51 Milano, Collezione "H. A." 2 (IV.B), pl. 1.1–3. CVA online vase #9007857.

B-20 (2) Arming and departure of warriors, and fighting warriors. Athenian black-figure amphora (Type B). The Painter of Berlin 1686. Vulci. c. 550–500 B.C. Paris, Bibliothèque Nationale, Cabinet des Médailles 207 (Anc. coll. Luynes no. 734). ABV 296, 6. CVA France 7 Paris, Bibliothèque Nationale (Cabinet des Médailles) 1 (III.H.e), pl. 34.3–5. CVA online vase #320385.

B-21 (1) Herakles fighting Amazon. Athenian black-figure lekythos. The Painter of New York 07 (Haspels). Attica. c. 550–500 B.C. New York, Metropolitan Museum of Art 07.286.43. Pl. 50.7a in von Bothmer (1957). CVA online vase #330202.

B-22 (2) Amazonomachy. Athenian black-figure cup. The Wraith Painter (Beazley) or the Group of Rhodes 12264 (Beazley). Sabucina, Sicily. c. 550–500 B.C. Caltanisetta, Museo Civico 20372 (811). CVA online vase #350763.

B-23 (2) **1 Scale.** Warriors fighting. Athenian black-figure skyphos. The Wraith Painter

(von Bothmer). c. 550–500 B.C. Liverpool, Public Museums 49.50.4. CVA online vase #350869.

B-24 (2) Warriors fighting. Athenian black-figure skyphos. The Wraith Painter (von Bothmer). c. 550–500 B.C. Marzabotto, Collection unknown, XXXX350870. CVA online vase #350870.

B-25 (2) Battle of five hoplites. Athenian black-figure hydria. c. 550–500 B.C. Warsaw, National Museum 142457. (Formerly Goluchow, Czartoryski Museum 18). CVA Pologne 1 Goluchow, Musée Czartoryski (III. He), pl. 10.1b. CVA online vase #14236.

B-26 (1) Battle of gods and giants (falling giant in Type IV). Etruscan black-figure neck-amphora. Vulci. c. sixth century B.C. Vatican City, Museo Gregoriano Etrusco Vaticano G91. Pl. 3.3 in Beazley (1947).

B-27 (2) Ajax carrying the body of Achilles. Athenian black-figure skyphos. The Camel Painter. Thespiai. c. 540 B.C. Athens, National Museum 433 (CC809). ABV 120, 5. CVA Greece 4 Athens, National Museum 4, pl. 14.1–2. CVA online vase #300865.

B-28 (1) Poseidon among departing Greek warriors. Athenian black-figure cup (Type A). The Amasis Painter (Hoffmann). Vulci. c. 540–530 B.C. New York, Metropolitan Museum of Art 1989.281.62. CVA online vase #350483.

B-29 (2) Battle scene. Athenian black-figure column-krater. The Wraith Painter. c. 540–530 B.C. Heidelberg, Ruprecht-Karls-Universität 264. ABV 689, 6 bis. CVA Deutschland 10 Heidelberg, Universität 1, pl. 40.9. CVA online vase #306573.

B-30 (2) Achilles and Ajax playing a game. Athenian black-figure olpe. Rome, Capitoline Museum, black-figure olpe no. 6A. c. 540–530 B.C. ABV 671, 3. CVA Italia 36 Roma, Musei Capitolini 1 (III, H), pl. 28.3–4. CVA online vase #306449.

B-31 (4+) Battle scene. Black-figure Little-Master band-cup. c. 540–530 B.C. Orvieto, Museo Civico, Coll. Faina 2547. CVA Italia 41 Orvieto, Museo C. Faina 1 (III–H), pl. 5.3. CVA online vase #8048.

B-32 (4+) **3 Scale.** Amazonomachy. Athenian black-figure Droop cup. The Wraith Painter. c. 530 B.C. Mainz, Johannes Gutenberg Universität 82. ABV 201, 12. CVA Deutschland 15 Mainz, Universität 1, pl. 45.1–3. CVA online vase #302589.

B-33 (2) Fight scene (Greeks against Greeks, and Greeks against Amazons). Athenian black-figure Droop cup. The Wraith Painter. c. 530–520 B.C. Athens, National Museum 661 (CC823). ABV 200, 11. CVA Greece 3 Athens, National Museum 3, pl. 43.1–2. CVA online vase #302588.

B-34 (1) Gigantomachy with quadriga. Athenian black-figure column-krater. c. 530–520 B.C. Geneva, Musée d'Art et d'Histoire 15041.1937. CVA Suisse 3 Genève, Musée d'Art et d'Histoire 2 (III.H), pls. 58.1, 58.4. CVA online vase #5686.

B-35 (2) Man (Agamemnon?) between quarrelling warriors (Ajax and Odysseus?). Athenian black-figure Little-Master band-cup. Boeotia. c. 530–520 B.C. Laon, Musée Archéologique Municipal 37.982. CVA France 20 Musée de Laon 1 (III.H), pl. 21.6. CVA online vase #12373.

B-36 (1) Warrior arming. Athenian black-figure lekythos. The Phanyllis Group (Haspels). c. 525–500 B.C. Cambridge, Fitzwilliam Museum GR6.1917. ABL 202, 24. CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.H), pl. 22.26. Fig. 237 in Boardman (1974). CVA online vase #472.

B-37 (1) Geryon. Athenian black-figure neck-amphora. Bologna. c. 525–475 B.C. Bologna, Museo Civico Archeologico GM3 (18). CVA Italia 7 Bologna, Museo Civico 2 (III.He), pl. 12.3. CVA online vase #14388.

B-38 (1) Gigantomachy: Athena and Herakles in a chariot being led by a female figure in a corselet. Athenian black-figure hydria. Manner of Lysippides. c. 520 B.C. Florence, Museo Archeologico Nazionale 3803. CVA Italia 42 Firenze, Museo Nazionale 5 (III-H), pl. 27.1. CVA online vase #8102.

B-39 (1) Fight, with warriors, youths, and old men intervening (sometimes cited as Ajax and Odysseus fighting over the arms of Achilles, or as Ajax fighting Hector). Athenian black-figure amphora (Type A). The Painter of Munich 1410 (Originally attributed to the Swing Painter). Vulci. c. 520 B.C. Munich, Antikensammlungen 1411 (J330). CVA Deutschland 3 München, Museum Antiker Kleinkunst 1 (III.H), pl. 43.1–2. CVA online vase #301594.

B-40 (1) Herakles fighting the hydra. Etruscan black-figure Caeretan hydria. The Eagle Painter (Hemelrijk). c. 520–510 B.C. Malibu, CA, J. Paul Getty Museum 83. AE.346. CVA USA 34 J. Paul Getty Museum 9 (Caeretan III.Fa), pl. 498.1. Fig. 494 in Boardman (1998). Fig. 180 in Carpenter (1991). CVA online vase #1002891.

B-41 (2) Herakles fighting warriors. Etruscan black-figure neck-amphora. The Micali Painter. c. 510 B.C. Würzburg, Martin von Wagner Museum HA18 (L798). CVA Deutschland 51 Würzburg, Martin von Wagner Museum 3, pls. 41.2, 42.6, 45.1. CVA online vase #1005913.

B-42 (2) Amphiaraos (named) mounting chariot and leaving home. Athenian black-figure amphora (Type A). The Priam Painter. Chiusi. c. 510 B.C. Chiusi, Museo Archeologico Nazionale 1794. ABV 330, 1. CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pls. 18.1, 19.1–2. CVA online vase #301779.

B-43 (2) Thanatos and Hypnos carrying the body of Sarpedon. Athenian black-figure neck-amphora. The Diosphos Painter. c. 500 B.C. New York, Metropolitan Museum of Art 56.171.25. (Formerly San Simeon, CA, Hearst Historical State Monument 9846). ABV 509, 137. CVA USA 16 New York, Metropolitan Museum of Art 4 (III.H), pl. 51.1. CVA online vase #305529.

B-44 (1) Victorious warrior rushing past fallen figure. Athenian black-figure lekythos (using Six's technique). The Diosphos Painter (Haspels). c. 500 B.C. University of Missouri-Columbia, Museum of Art and Archaeology 58.12. CVA USA 36 University of Missouri-Columbia, Museum of Art and Archaeology 1, pl. 25.2–3. CVA online vase #2933.

B-45 (1) Centauromachy. Athenian black-figure kyathos. The Caylus Painter (Leafless Group). c. 500–490 B.C. Göttingen, University Archaeological Institute K325. CVA Deutschland 83 Göttingen, Archäologisches Institut der Universität 3, pl. 59.1–2.

B-46 (1) Hypnos and Thanatos carrying the body of Sarpedon. Athenian black-figure lekythos. The Athena Painter. c. 500–480 B.C. Berlin, Antikensammlung 3252 (formerly Pergamonmuseum 3252). ABV 522, 28. ABL 255, 28. Fig. 251 in Boardman (1974). CVA online vase #330735.

B-47 (2) Fighting warriors. Etruscan black-figure ovoid neck-amphora. c. 500–475 B.C. Warsaw, National Museum 198092. CVA Pologne 9 Varsovie, Musée National 6 (IV.B), pl. 48.3–4. CVA online vase #1012361.

B-48 (6) Battle scene, including Aeneas and a winged Aphrodite. Etruscan black-figure

belly-amphora. Vulci. c. 470 B.C. Würzburg, Martin von Wagner Museum HA25 (L799).

White-Ground Technique Vases

W-1 (1) Ethiopian warrior wearing corselet and black cloak, with bow and axe, between palm tree and table. White-ground alabastron. The Painter of the Negro Alabastra. c. 500 B.C. Champaign-Urbana, University of Illinois, Krannert Art Museum 72.13.3. CVA USA 24 Urbana-Champaign, University of Illinois 1 (III.J), pl. 32.4. CVA online vase #5156.

W-2 (1) Ethiopian warrior carrying bow and battle axe, with stool and palm tree. White-ground alabastron. The Group of the Negro Alabastra. Thebes. c. 500–480 B.C. Athens, National Museum 422 (CC1088). ARV 268, 9. CVA online vase #202787.

W-3 (1) Ethiopian archer by palm tree. White-ground alabastron. The Group of the Negro Alabastra. Thebes. c. 500–450 B.C. Athens, National Museum 423 (CC1089). ARV 268, 10. CVA online vase #202788.

W-4 (1) **1 Scale.** Sacrifice of Iphigeneia (Warrior at altar leading Iphigeneia). White-ground lekythos. Douris. Selinus, Sicily. c. 490 B.C. Palermo, Museo Archeologico Regionale 1886. ARV 446, 266. Fig. 299 in Carpenter (1991). CVA online vase #205315.

W-5 (1) Amazon with quiver and axe by a table and palm tree. White-ground alabastron. The Group of the Negro Alabastra (Beazley). Camiros, Rhodes. c. 480 B.C. London, British Museum B673 (GR 1864,1007.253). ARV 268, 33. Pl. 73.3 in von Bothmer (1957). CVA online vase #202811.

W-6 (1) Amazon with pick and pelta with apron, by altar and palm tree. White-ground alabastron. Reputed to be from Turkey. c. 480 B.C. Karlsruhe, Badisches Landesmuseum 69.34. CVA Deutschland 60 Karlsruhe, Badisches Landesmuseum 3, pl. 25.2–4. CVA online vase #4703.

W-7 (1) Ethiopian archer with axe by table and palm tree. White-ground alabastron. The Group of the Negro Alabastra. c. 480 B.C. Kiel, Antikensammlung B528. CVA Deutschland 55 Kiel, Kunsthalle, Antikensammlung 1, pl. 47.1–3.

W-8 (1) Ethiopian archer with axe by table and palm-tree. White-ground alabastron. The Group of the Negro Alabastra. Tanagra (Boeotia). c. 480 B.C. London, British Museum B674 (GR 1875,0309.24). ARV 267, 1. Fig. 208 in Boardman (1975). In Sekunda (1992), 16. CVA online vase #202779.

W-9 (1) Ethiopian with an axe in front of a palm-tree. White-ground alabastron. The Group of the Negro Alabastra. Athens. c. 480–470 B.C. Athens, National Museum, Vlastos-Serpieris Collection 157.

W-10 (1) Warrior and woman at tomb. White-ground lekythos. The Thanatos Painter. Athens. c. 455–430 B.C. Athens, National Museum 1761 (CC1678). ARV 1229, 17. CVA online vase #216358.

W-11 (1) Warrior and woman at tomb. White-ground lekythos (known as "The Otago Lekythos"). The Achilles Painter. c. 450–425 B.C. New Zealand, Otago Museum.

W-12 (1) Hypnos and Thanatos carrying body of a warrior (Sarpedon?). White-ground lekythos. The Thanatos Painter. Ambelokipi. c. 440–435 B.C. London, British Museum D58. ARV 1228, 12. CVA online vase #216353.

Red-Figure Vases

R-1 (3+) Ajax and Achilles playing a game, with Athena between them, and surrounded by warriors. Athenian red-figure cup. Epiktetos. Vulci. c. 525–500 B.C. Aberdeen University 64347 (744) and Florence 1B29. ARV 73, 28. Pl. 59 in Woodford (1993). CVA Italia 8 Firenze, Museo Archeologico Etrusco 1 (III.I), pl. 1.29. CVA online vase #200472.

R-2 (1) Warrior mounting chariot, turned toward a bearded warrior (in Type IV). Athenian red-figure amphora (Type A). Euthymides. Vulci. c. 525–500 B.C. Paris, Musée du Louvre G44. ARV 27, 3. CVA France 8 Paris, Musée du Louvre 5 (III.I.c), pls. 29.1, 29.6. CVA online vase #200156.

R-3 (1) **1 Scale**. Achilles (named). Athenian red-figure belly amphora (Type C). Oltos, painter; Euxitheos, potter (signed). Vulci. c. 525–500 B.C. London, British Museum E258. ARV 54, 4. CVA Great Britain 4 London, British Museum 3 (III.I.c), pls. 5.1b, 5.1d. Pl. 57.2 in Boardman (1975). CVA online vase #200436.

R-4 (1) Libation scene of warrior leaving home. Athenian red-figure neck-amphora (Nolan amphora with twisted handles). The Berlin Painter. Nola, Italy. c. 525–475 B.C. London, British Museum E269 (GR 1836,0224.76). ARV 199, 27. CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 9.3a. CVA online vase #201835.

R-5 (1) Libation scene of warrior leaving home. Athenian red-figure lekythos. The Berlin Painter. Gela, Sicily. c. 525–475 B.C. Palermo, Museo Archeologico Regionale V667 (2134). ARV 211, 194. CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 20.1. CVA online vase #202013.

R-6 (1) Warrior. Athenian red-figure neck-amphora (Nolan amphora with triple handles). The Berlin Painter. c. 525–475 B.C. Vienna, Kunsthistorisches Museum 654. ARV 201, 67. CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 54.2. CVA online vase #201875.

R-7 (1) Warriors arming. Athenian red-figure cup. The Hischylos Painter. Vulci. c. 525–475 B.C. Munich, Antikensammlungen 2588 (J1160). ARV 162, 2. Fig. 86 in Boardman (1975). CVA online vase #201515.

R-8 (1) Herakles fighting Kyknos, with chariots at each side. Athenian red-figure cup. The Nikosthenes Painter; Pamphaios, potter (signed). Tarquinia. c. 525–475 B.C. Tarquinia, Museo Nazionale Tarquiniense RC2066. ARV 126, 23. CVA Italia 25 Tarquinia, Museo Nazionale Tarquiniense 1 (III.I), pl. 6.2. CVA online vase #201051.

R-9 (1) **1 Horseback**. Amazon on horseback. Interior of Athenian red-figure cup. Oltos. c. 525–475 B.C. Paris, Musée du Louvre G94 BIS. ARV 66, 133. CVA France 17 Paris, Musée du Louvre 10 (III.I.b), pl. 7.1. Pl. 72.6 in von Bothmer (1957). CVA online vase #200571.

R-10 (2) Theseus abducting the Amazon Antiope in a chariot, followed by warriors. Athenian red-figure cup. Oltos, painter; Kachrylion, potter (signed). Vulci. c. 525–475 B.C. London, British Museum E41. ARV 58, 51. Pl. 68.4 in von Bothmer (1957). CVA online vase #200441.

R-11 (3) Centauromachy. Athenian red-figure psykter. Onesimos (Hartwig). Civita Castellana (Falerii veteres). c. 525–475 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 3577. CVA Italia 1 Roma, Museo Nazionale Etrusco di Villa Giulia 1 (III.I.c), pls. 3.2–3, 4.2–3. CVA online vase #2352.

R-12 (2) Warriors fighting. Athenian red-figure cup. The Delos Painter. c. 520

B.C. Leipzig, Antikenmuseum der Universität T 500 and Rome, Museo Nazionale Etrusco di Villa Giulia XXXX0.1558 (2 fragments). ARV 172, 2. CVA Deutschland 80 Leipzig, Antikenmuseum der Universität 3, pl. 9.2. CVA online vase #201558.

R-13 (1) Herakles fighting Kyknos, with Ares (wearing Type IV) at right. Athenian red-figure cup. The Euergides Painter; Euergides, potter (signed). c. 520–510 B.C. Toledo (Ohio) Museum of Art 1961.25. ARV 90, 36. CVA USA 17 Toledo Museum of Art 1 (III.I), pl. 48.1. CVA online vase #200731.

R-14 (1) Warrior. Fragment of Athenian red-figure cup. c. 520–510 B.C. Tübingen, Eberhard-Karls-Universität, Archäologisches Institut S101533. CVA Deutschland 54 Tübingen, Antikensammlung des Archäologischen Instituts der Universität 5, pl. 1.7. CVA online vase #30287.

R-15 (1+) Hypnos and Thanatos carry Sarpedon off the battlefield. Athenian red-figure calyx-krater. Euphronios, painter (signed); Euxitheos, potter (signed). Etruria, near Cerveteri. c. 520–500 B.C. New York, Metropolitan Museum of Art 1972.11.10. Pl. 22 in Boardman (1975). Fig. 310 in Carpenter (1991). CVA online vase #187.

R-16 (1) Herakles fighting Amazons. Athenian red-figure cup. Oltos. Vulci. c. 520–510 B.C. London, British Museum E18. ARV 62, 86. Pl. 69.2 in von Bothmer (1957). CVA online vase #200522.

R-17 (3) Fight for the corpse of Patroklos. Athenian red-figure cup. Oltos, painter (signed); Euxitheos, potter (signed). Vulci. c. 515–510 B.C. Berlin, Antikensammlung F2264 (Pergamonmuseum F2264). ARV 60, 64. CVA Deutsche Demokratische Republik 3 Berlin, Staatliche Museen zu Berlin, Antikensammlung-Pergamonmuseum 1, pls. 2.2, 3.1–2. CVA online vase #200457.

R-18 (1) Warrior dismounting from chariot to attack fleeing opponent. Red-figure cup (Type B). Manner of the Epeleios Painter. Vulci. c. 510 B.C. Amsterdam, Allard Pierson Museum 3361. ARV 149, 8. CVA The Netherlands 6 Amsterdam, Allard Pierson Museum 1 (III.I), pl. 15.2a, 15.3a.

R-19 (1) Running warrior. Interior of Athenian red-figure cup (Type B). Cups Mingling Epeleian and Euergidean Elements (Beazley). c. 510 B.C. Paris, Musée du Louvre S1385 (CP 11258A). ARV 104, 6. CVA France 28 Louvre 19 (III.I.b), pl. 54.2. CVA online vase #200908.

R-20 (3) Herakles fighting Geryon. Athenian red-figure cup (Type B). Euphronius, painter (signed); Kachrylion, potter (signed). Vulci. c. 510 B.C. Munich, Antikensammlungen 2620 (8704) (J337). ARV 16, 17. Pl. 26.1–2 in Boardman (1975). CVA online vase #200080.

R-21 (1) Neoptolemos attacking Priam with body of Astyanax. Athenian red-figure hydria. The Painter of the Munich Amphora. Etruria. c. 510 B.C. Berlin, Antikensammlung F2175B (Schloss Charlottenburg F2175). ARV 246, 11. CVA Deutschland 74 Berlin, Antikensammlung (formerly Antiquarium) 9, pl. 3.1. CVA online vase #202461.

R-22 (3) Fight scene (Theseus against the Amazons?). Athenian red-figure cup. Manner of the Nikosthenes Painter. c. 510 B.C. Geneva, Musée d'Art et d'Histoire 20152. ARV 1628, 9 bis. CVA Suisse 3 Genève, Musée d'Art et d'Histoire 2 (III.I), pl. 89.1–2. CVA online vase #275060.

R-23 (1) Theseus carrying the Amazon Antiope to a chariot, followed by warriors. Athenian red-figure cup. Oltos. c. 510 B.C. Oxford, Ashmolean Museum 1927.4065. ARV 62, 77. CVA Great Britain 9 Oxford, Ashmolean Museum 2 (III.I), pl. 53.3–4. Pl. 68.6a–b in von Bothmer (1957). CVA online vase #200513.

R-24 (1) Battle scene with mounted and foot warriors. Athenian red-figure cup. Manner of the Epeleios Painter. Vulci. c. 510–500 B.C. Laon, Musée Archéologique Municipale 37.1054. ARV 150, 23. CVA France 20 Laon, Musée de Laon 1 (III.I), pl. 46.1. CVA online vase #201348.

R-25 (3) Herakles and Telamon fighting Amazons. Athenian red-figure volute-krater. Euphronios. Perhaps from Arezzo. c. 510–500 B.C. Arezzo, Museo Archeologico Nazionale 1465. ARV 15, 6. Pl. 69.3a in von Bothmer (1957). Pl. 29 in Boardman (1975). CVA online vase #200068.

R-26 (1) **1 Arming**. Hector arming, between Priam and Hecuba. Athenian red-figure belly amphora (Type A). Euthymides (signed). Vulci. c. 510–500 B.C. Munich, Antikensammlungen 2307 (J378) (8731). ARV 26, 1. CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 165.1, 166.1, 172.1. CVA online vase #200160.

R-27 (5) Herakles fighting Amazons; running Amazons. Exterior and interior of Athenian red-figure cup. The Proto-Panaetian Group. Vulci. c. 510–500 B.C. London, British Museum E45 (GR 1836.2–24.101). ARV 316, 8. CVA Great Britain 17 London, British Museum 9, pls. 4–5. Pl. 69.4a–b in von Bothmer (1957). CVA online vase #203248.

R-28 (1) **1 Arming.** Amazon or warrior tying belt around Type IV. Athenian red-figure volute-krater fragment. The Kleophrades Painter. c. 510–475 B.C. Paris, Cabinet des Médailles 863. ARV 187, 53. CVA online vase #201705.

R-29 (1) Orestes killing Aigisthos. Athenian red-figure pelike. The Berlin Painter. Cerveteri. c. 500 B.C. Vienna, Kunsthistorisches Museum 3725 (333). ARV 204, 109. CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 68.2. CVA online vase #201917.

R-30 (7) **1 Arming/Scale, 4 Other Scale**. Warrior bidding farewell to his wife; the Seven arm for fight against Thebes. Interior and exterior of Athenian red-figure cup. Douris, painter (signed); Python, potter (signed). Cerveteri. c. 500 B.C. Vienna, Kunsthistorisches Museum 3694. ARV 427, 3. CVA Österreich 1 Wien, Kunsthistorisches Museum 1 (III.I), pls. 9.1–2, 10.1–2. Pl. 281 in Boardman (1975). CVA online vase #205047.

R-31 (3) Battle scene. Athenian red-figure cup. Manner of the Epeleios Painter. c. 500 B.C. Florence, Museo Archeologico Etrusco 3965. ARV 149, 14. CVA Italia 30 Firenze, Regio Museo Archeologico Etrusco 3 (III.I), pl. 82.1, 82.3. CVA online vase #201339.

R-32 (1) **1 Arming.** Thorykion arming, flanked by archers in Scythian gear. Athenian red-figure belly amphora (Type A). Euthymides (signed). Vulci. c. 500 B.C. Munich, Antikensammlungen 2308 (J374). ARV 26, 2. CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 169.1, 170.1, 172.2. CVA online vase #200161.

R-33 (1) Departure of warrior from home, with libation. Athenian red-figure belly amphora (Type A). The Kleophrades Painter. Vulci. c. 500 B.C. Munich, Antikensammlungen 2305 (J411). ARV 182, 4. CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 173.1, 174.1, 175.1. CVA online vase #201657.

R-34 (1) Departure of warrior, with extispicy. Athenian red-figure belly amphora (Type A). The Kleophrades Painter. Vulci. c. 500 B.C. Würzburg, Universität, Martin von Wagner Museum L507 (HA120). ARV 181, 1. CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pl. 8.1. Pl. 129.1 in Boardman (1975). CVA online vase #201654.

R-35 (1) **1 Scale**. Agamemnon (named) leads away Briseis. Athenian red-figure skyphos. Makron, painter; Hieron, potter (signed).

c. 500 B.C. Paris, Musée du Louvre G146. ARV 458, 2. In Sekunda (2000), 32. CVA online vase #204682.

R-36 (1) **1 Scale**. Warrior leaning on spear and old man. Interior of Athenian red-figure cup. Makron, painter; Hieron, potter (signed). c. 500 B.C. Lausanne, private collection. ARV 471, 185. Pl. 315 in Boardman (1975). CVA online vase #204868.

R-37 (2) **2 Scale**. Akamas and Demophon rescue Aithra (all named). Athenian red-figure calyx-krater. Myson. c. 500 B.C. London, British Museum E458. ARV 239, 16. Pl. 172.2 in Boardman (1975). CVA online vase #202164.

R-38 (1) Centauromachy (Kaineus). Athenian red-figure column-krater. Myson. Ruvo, Italy. c. 500 B.C. Naples, Museo Archeologico Nazionale H2410 (M1210) (81399). ARV 239, 18. Pl. 170 in Boardman (1975). CVA online vase #202367.

R-39 (2) **2 Scale**. Theseus abducting Antiope, Queen of the Amazons, with Peirithoos. Athenian red-figure amphora (Type A). Myson. Vulci. c. 500 B.C. Paris, Musée du Louvre G197. ARV 238, 1. CVA France 9 Louvre 6 (III.I.c), pl. 35.3, 35.6–7. Pl. 68.5 in von Bothmer (1957). CVA online vase #202176.

R-40 (2) Warriors with woman (Nike?). Attic red-figure vase fragments (mouth of a hydria). Style of the Nikoxenos Painter (CVA). c. 500 B.C. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. 8.97.

R-41 (1) Iliupersis: Ajax attacking Cassandra. Athenian red-figure cup (Type C) fragment. Onesimos, painter; Euphronios, potter (signed). c. 500 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 121110 (formerly Malibu, J. Paul Getty Museum 83.AE.362). Pl. 42 in Holliday (1993). CVA online vase #13363.

R-42 (3) Warriors (or Hypnos and Thanatos) carrying Patroklos off battlefield. Athenian red-figure calyx-krater. The Pezzino Group. Agrigento. c. 500 B.C. Agrigento, Museo Archeologico Regionale C1956. ARV 32, 2. Pl. 70 in Woodford (1993). CVA online vase #200177.

R-43 (2) **2 Scale**. Achilles bandaging Patroklos. Athenian red-figure cup interior. The Sosias Painter; Sosias, potter (signed). Vulci. c. 500 B.C. Berlin, Antikensammlung F2278 (formerly Schloss Charlottenburg F2278). ARV 21, 1. CVA Deutschland 21 Berlin, Antiquarium 2, pl. 49.1. Pl. 23 in Woodford (1993). Fig. 50.1 in Boardman (1975). Fig. 301 in Carpenter (1991). CVA online vase #200108.

R-44 (1) **1 Scale**. Warrior leaning on spear, with boy. Interior of Athenian red-figure cup. A painter of the Thorvaldsen Group. c. 500 B.C. New York, Metropolitan Museum of Art 41.162.1. CVA USA 1 Hoppin and Gallatin Collections/Gallatin Collection (III.I.c), pl. 10.1.

R-45 (1) Gigantomachy: Athena attacking fallen giant wearing corselet. Athenian red-figure hydria (kalpis type). c. 500 B.C. Champaign-Urbana, University of Illinois, Krannert Art Museum K70.7.1. CVA USA 24 University of Illinois, Urbana-Champaign 1 (III.I), pl. 21.2, 21.4. CVA online vase #18466.

R-46 (1) **1 Scale**. Warrior making libation before departure. Athenian red-figure hydria. c. 500 B.C. Boston, Museum of Fine Arts 98.878. ARV 1596, Boston 98.878. Pl. 6 in Anderson (1970). CVA online vase #9017571.

R-47 (1) Helmeted warrior. Attic red-figure cup fragment (brim or edge). c. 500 B.C. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. 4.69.

R-48 (1) Crouching warrior (or Amazon). Interior of Athenian red-figure cup (Type C).

Apollodoros. c. 500–490 B.C. Basel, Antikenmuseum und Sammlung Ludwig BS472. CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 7.3, 33.6. CVA online vase #9919.

R-49 (8) Herakles fighting Amazons. Athenian red-figure neck-amphora. The Berlin Painter. c. 500–490 B.C. Basel, Antikenmuseum und Sammlung Ludwig BS453. ARV 1634, 30 bis. CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2. Pl. 149 in Boardman (1975). CVA online vase #275091.

R-50 (1) Greek hoplite and Scythian archer running. Interior of Athenian red-figure cup. Douris. Chiusi. c. 500–490 B.C. Baltimore, MD, Johns Hopkins University B8. ARV 442, 215. CVA USA 6 Baltimore, MD, Robinson Collection 2 (III.I), pl. 11.1a. CVA online vase #205260.

R-51 (1) Ajax killing Troilos. Interior of Athenian red-figure cup. Onesimos (Hartwig); Euphronios, potter (signed). Vulci. c. 500–485 B.C. Perugia, Museo Civico 89. ARV 320, 8. Pl. 232 (drawing) in Boardman (1975). CVA online vase #203224.

R-52 (2) **1 Arming/Scale, 1 Carried/Scale**. Odysseus giving Achilles's armor to Neoptolemos; Ajax and Odysseus quarrelling over the arms of Achilles. Interior and exterior of Athenian red-figure cup. Douris (signed). Cerveteri. c. 500–480 B.C. Vienna, Kunsthistorisches Museum 3695 (formerly Österreichisches Museum 325). ARV 429, 26. CVA Österreich 1 Wien, Kunsthistorisches Museum 1 (III.I), pls. 11.1–2, 12.1. Pls. 92, 96 in Woodford (1993). Fig. 285.2 in Boardman (1975). CVA online vase #205070.

R-53 (1) Warrior pouring libation at altar. Interior of Athenian red-figure cup. The Painter of Athens P42. Athens (the Agora). c. 500–480 B.C. Athens, Agora Museum P42. ARV 415, 1. In Sekunda (2002), 86. CVA online vase #204524.

R-54 (1) Gigantomachy: Athena wounding the giant Enkelados (in Type IV). Athenian red-figure hydria (kalpis type). The Tyszkiewicz Painter. Vulci. c. 500–480 B.C. London, British Museum E165. ARV 294, 62. CVA Great Britain 7 London, British Museum 5 (III.I.c), pls. 71.3, 72.4.

R-55 (1) Gigantomachy: Poseidon fighting the giant Ephialtes. Athenian red-figure column-krater. The Class of Cabinet des Médailles 390 (Beazley). Sicily. c. 500–475 B.C. Vienna, Kunsthistorisches Museum 688. ARV 255, 2. CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 86.1, 86.3. CVA online vase #202916.

R-56 (3) Combat of Herakles and Greek warriors against Amazons. Athenian red-figure volute-krater fragments. The Kleophrades Painter. c. 500–470 B.C. Paris, Musée du Louvre G166. ARV 186, 51. CVA France 2 Louvre 2 (III.I.c), pls. 17.2, 18.1. (According to Beazley, 2 of these fragments, once glued together, are from different pots; he attributes the Herakles fragment, CVA France 2 Louvre 2 (III.I.c), pls. 18.3 and 19.1, to the Berlin Painter and lists it as ARV 206, 130.) CVA online vase # 201704.

R-57 (3) Leave-taking of warrior and libation, and Patroklos taking leave of Achilles. Athenian red-figure stamnos. The Kleophrades Painter. Vignanello. c. 500–470 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 26040. ARV 188, 63. CVA Italia 1 Roma, Museo Nazionale Etrusco di Villa Giulia 1 (III.I.c), pl. 6.1–3. CVA online vase #201713.

R-58 (1) Neoptolemos carrying Astyanax. Athenian red-figure neck-amphora with double handles. The Alkimachos Painter. c. 500–450 B.C. Madrid, Museo Arqueológico Nacional 11101 (L178). ARV 530, 23. CVA

Espagne 2 Madrid, Museo Arqueológico Nacional 2 (III.I.c), pl. 20.4a. CVA online vase #205999.

R-59 (1) **1 Arming**. Warrior putting on armor, assisted by woman and older man. Athenian red-figure column-krater. The Alkimachos Painter. c. 500–450 B.C. Madrid, Museo Arqueológico Nacional 11042 (L168). ARV 532, 49. CVA Espagne 2 Madrid, Museo Arqueológico Nacional 2 (III.I.c), pl. 16.1a. CVA online vase #206026.

R-60 (1) Warrior with shield and spear attacking slinger. Athenian red-figure neck-amphora (small Nolan amphora with double handles). The Alkimachos Painter. c. 500–450 B.C. London, British Museum E285. ARV 530, 25. CVA Great Britain 7 British Museum 5 (III.I.c), pl. 46.3B. CVA online vase #206001.

R-61 (1) **1 Arming/Scale**. Warrior arming. Athenian red-figure volute-krater. The Boreas Painter. Bologna. c. 500–450 B.C. Bologna, Museo Civico Archeologico, Pell. 274. ARV 536, 3. CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 53.1, 53.3, 55.7. CVA online vase #206069.

R-62 (1) Centauromachy (Kaineus wearing Type IV). Athenian red-figure column-krater. The Cleveland Painter. Vitorchiano. c. 500–450 B.C. Harrow, School Museum 50 (T50GW26). ARV 516, 5. Pl. 37 in Boardman (1989). CVA online vase #205793.

R-63 (1) **1 Arming**. Warrior putting on corselet. Athenian red-figure cup. The Dokimasia Painter. c. 500–450 B.C. Formerly Berlin 3233 (now lost). ARV 414, 32. CVA DDR 3 Berlin, Staatliche Museen zu Berlin, Antikensammlung-Pergamonmuseum 1, Missing Vases image 21. CVA online vase #204514.

R-64 (5) **1 Scale**. Warriors arming. Interior and exterior of Athenian red-figure cup. The Foundry Painter. c. 500–450 B.C. Brussels, Musées Royaux R322. ARV 402, 17. CVA Belgique 1, Bruxelles, Musées Royaux du Cinquantenaire 1 (III.I.c), pl. 3.1b–d. CVA online vase #204358.

R-65 (1) Herakles fighting Amazons. Athenian red-figure hydria (kalpis type). The Leningrad Painter. c. 500–450 B.C. London, British Museum E167. ARV 571, 77. CVA Great Britain 7 British Museum 5 (III.I.c), pls. 73.1, 79.1b. Pl. 70.1 in von Bothmer (1957). CVA online vase #206568.

R-66 (1) **1 Horseback**. Warrior (Amazon?) on horseback. Athenian red-figure column-krater. Myson. c. 500–450 B.C. St. Petersburg, State Hermitage Museum 632 (ST1602). ARV 240, 43. Pl. 73.6 in von Bothmer (1957). CVA online vase #202392.

R-67 (1) **1 Horseback**. Archer on horseback. Interior of Athenian red-figure cup. Onesimos. Orvieto. c. 500–450 B.C. Orvieto, Museo Civico, Coll. Faina 65. ARV 329, 132. CVA online vase #203387.

R-68 (6) **1 Carried/Scale**. Achilles mourning, with his armor brought to him by Thetis and Nereids; Centauromachy. Athenian red-figure neck-amphora. The Oreithyia Painter (Beazley) or the Copenhagen Painter. c. 500–450 B.C. Universität Zürich, Archäologische Sammlung L5. ARV 1656, 2 bis. Fig. 31 in Boardman (1989). CVA online vase #275252.

R-69 (1) **1 Horseback**. Amazon on horseback. Athenian red-figure column-krater. The Painter of Bologna 228. c. 500–450 B.C. Munich, Antikensammlungen 2379. ARV 512, 10. Pl. 83.1 in von Bothmer (1957). CVA online vase #205747.

R-70 (1) **1 Arming**. Warrior arming, between older man and two women. Athenian red-figure column-krater. The Syracuse Painter. Bomarzo, Italy. c. 500–450 B.C.

London Market, Christie's XXXX205808. ARV 518, 3. CVA online vase #205808.

R-71 (1) **1 Arming/Scale**. Warrior arming, helped by woman. Athenian red-figure neck-amphora (Nolan amphora with triple handles). The Triptolemos Painter. Orvieto. c. 500–450 B.C. Brussels, Musées Royaux d'Art et d'Histoire R308. ARV 362, 16. CVA Belgique 2 Brussels, Musées Royaux d'Art et d'Histoire (Cinquantenaire) 2 (III.I.c), pl. 15.3a, 15.3c. CVA online vase #203807.

R-72 (1) **1 Horseback**. Mounted warrior. Interior of Athenian red-figure cup. The Antiphon Painter. Orvieto. c. 490 B.C. Orvieto, Faina Collection no. 48. In Sekunda (2002), 51.

R-73 (2) Two warriors with spears. Athenian red-figure volute-krater. The Berlin Painter. Cerveteri. c. 490 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia V99. ARV 206, 131. CVA Italia 64 Roma, Museo Nazionale Etrusco di Villa Giulia 4, pl. 14.1–2. CVA online vase #201940.

R-74 (1) Gigantomachy: Hephaistos, wielding glowing coals, in Type IV. Athenian red-figure cup (Type B). The Brygos Painter. Vulci. c. 490 B.C. Berlin, Antikensammlung F2293. ARV 370, 10. CVA Deutschland 21 Berlin, Antiquarium 2, pls. 67.2, 68.4; CVA Deutschland 22 Berlin, Antiquarium 3, pl. 126.3.

R-75 (2) Sack of Troy, and Neoptolemos beating Priam with body of Astyanax. Athenian red-figure cup. The Brygos Painter (signed). Vulci. c. 490 B.C. Paris, Musée du Louvre G152. ARV 369, 1. Fig. 145 in Boardman et al. (1967). Fig. 245.2 in Boardman (1975). CVA online vase #203900.

R-76 (1) Athena slaying the giant Enkelados. Athenian red-figure lekythos. Douris (Kozloff). c. 490 B.C. Cleveland (OH) Museum of Art 1978.59 (78.59). CVA USA 35 Cleveland (OH), Museum of Art 2, pls. 70.3, 71.2. CVA online vase #5168.

R-77 (2) **2 Scale**. Fights: Menelaus against Paris, and Ajax against Hektor. Athenian red-figure cup (Type C). Douris, painter (signed); Kalliades, potter (signed). Santa Maria Capua Vetere. c. 490 B.C. Paris, Musée du Louvre G115. ARV 434, 74. Pl. 144 in Arias (1962). Pl. 305 in Carpenter (1991). CVA online vase #205119.

R-78 (2) Warriors fighting. Athenian red-figure cup. The Triptolemos Painter. Orvieto. c. 490 B.C. Berlin, Antikensammlung F2295 (Schloss Charlottenburg F2295). ARV 364, 45. CVA Deutschland 21 Berlin, Antiquarium 2, pl. 64.3–4. CVA online vase #203837.

R-79 (1) Amazon. Athenian red-figure Panathenaic amphora. The Berlin Painter. c. 490–480 B.C. Florence, Museo Archeologico Etrusco 3989. ARV 198, 14. CVA Italia 13 Firenze, Museo Archeologico 2 (III.I), pl. 27.2–3. Pl. 73.1b in von Bothmer (1957). CVA online vase #201822.

R-80 (1) Chrysippos being served wine by Zeuxo. Interior of Athenian red-figure cup (Type C). The Brygos Painter (signed). Capua. c. 490–480 B.C. London, British Museum E65 (1873.8-10.376). ARV 370, 13. CVA Great Britain 17 London, British Museum 9, pl. 62. CVA online vase #203912.

R-81 (7) **1 Carried**. Old man holding helmet next to arming warrior; group scene of warriors arming. Interior and exterior of Athenian red-figure cup. The Brygos Painter (Duemmler). Vulci. c. 490–480 B.C. Vatican City, Museo Gregoriano Etrusco Vaticano 16583. ARV 373, 48. Fig. 12 in Jarva (1995). CVA online vase #203946.

R-82 (2) Achilles attacking Memnon, while Thetis and Eos watch. Athenian red-figure cup (Type C). The Castelgiorgio Painter.

Vulci. c. 490–480 B.C. London, British Museum E67 (1836.2-24.131). ARV 386, 3. CVA Great Britain 17 London, British Museum 9, pl. 67. Pl. 86 in Woodford (1993). CVA online vase #204134.

R-83 (1) Warrior. Fragments of interior of Athenian red-figure cup. Douris (signed). Probably from Depoletti. c. 490–480 B.C. Bonn, Akademisches Kunstmuseum 76 and Florence, Museo Archeologico Etrusco 11B39. ARV 434, 75. CVA Deutschland 1 Bonn, Akademisches Kunstmuseum 1, pl. 4.1; CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. 11.39. CVA online vase #205120.

R-84 (2) Battle scene. Athenian red-figure cup. The Foundry Painter. c. 490–480 B.C. Cambridge, MA, Harvard University, Arthur M. Sackler Museum 1917.149 (1642.95). ARV 402, 16. CVA USA 8 Cambridge, MA, Fogg Museum and Gallatin Collections (Fogg Museum III.I), pl. 13.1b, 13.1d. CVA online vase #204357.

R-85 (1) **1 Scale**. Lapith fighting centaur. Interior of Athenian red-figure cup. The Foundry Painter; Euphronios, potter. Vulci. c. 490–480 B.C. Munich, Antikensammlungen 2640 (J368). ARV 402, 22. Fig. 268 in Boardman (1975). CVA online vase #204363.

R-86 (1) Warrior (wiping his helmet?). Athenian red-figure cup fragment. The Foundry Painter. Orvieto. c. 490–480 B.C. Leipzig, Antikenmuseum der Universität T542. ARV 403, 30. CVA Deutschland 80 Leipzig, Antikenmuseum der Universität 3, pl. 41.1. CVA online vase #204371.

R-87 (2) Herakles fighting Amazons. Athenian red-figure column-krater. The Harrow Painter. c. 490–480 B.C. Rome, Musei Capitolini 185 (23). ARV 274, 41. CVA Italia 39 Roma, Musei Capitolini 2 (III.I), pl. 18.1–3. Pl. 70.2 in von Bothmer (1957). CVA online vase #202877.

R-88 (2) Centauromachy. Athenian red-figure hydria (kalpis type). The Kleophrades Painter. Vulci. c. 490–480 B.C. Leiden, Rijksmuseum van Oudheden PC83. ARV 188, 71. CVA The Netherlands 5 Leiden, Rijksmuseum van Oudheden 3 (III.I), pls. 139.1, 139.3, 140.1–2. CVA online vase #201719.

R-89 (8) Sack of Troy: Death of Priam, Ajax assaulting Cassandra by the Palladion, Aeneas carrying Anchises, and rescue of Aithra. Athenian red-figure hydria (kalpis type). The Kleophrades Painter. Nola, Italy. c. 490–480 B.C. Naples, Museo Archeologico Nazionale H2422 (81669) (M1480). ARV 189, 74. Pl. 135 in Boardman (1975). Pl. 144 in Boardman et al. (1967). CVA online vase #201724.

R-90 (1) Warrior in patterned corselet. Athenian red-figure cup fragment. Onesimos (Riccioni) or late phase of the Panaitios Painter (CVA). Adria. c. 490–480 B.C. Adria, Museo Archeologico Nazionale 22129 (BD3). ARV 1559 (kalos-name Agasias). CVA Italia 28 Adria, Museo Civico 1 (III.I), pl. 4.5. CVA online vase #9009456.

R-91 (1) Warriors and youths. Athenian red-figure cup. The Painter of Berlin 2268. Vulci. c. 490–480 B.C. Cambridge, Fitzwilliam Museum 37.16 (GR16.1937). ARV 155, 37. CVA Great Britain 11 Cambridge, Fitzwilliam Museum 2 (Ricketts and Shannon Collection III.I), pl. 6.1b. CVA online vase #201440.

R-92 (4) **3 Scale**. Gigantomachy. Athenian red-figure cup. The Painter of the Paris Gigantomachy (name vase). Vulci. c. 490–480 B.C. Paris, Cabinet des Médailles 573. ARV 417, 1. Pl. 280.2 in Boardman (1975). CVA online vase #204546.

R-93 (3) **1 Scale**. Greeks fighting Persians. Athenian red-figure cup (known as "The Basseggio Cup"). The Painter of the Paris

Gigantomachy. Vulci. c. 490–480 B.C. New York, Metropolitan Museum 1980.11.21. ARV 417, 4. Fig. 6 in Krentz (2010). CVA online vase #204549.

R-94 (1) **1 Scale**. Warrior's arms and armor. Athenian red-figure hydria. Etruria. c. 490–480 B.C. Paris, Musée du Louvre G179 (MN52). CVA France 9 Paris, Musée du Louvre 6 (III.I.c), pl. 54.4, 54.6. CVA online vase #5758.

R-95 (2) Duel of Achilles and Memnon in the presence of Eos and Thetis. Athenian red-figure cup (Type C). The Brygos Painter (Duemmler). Tarquinia. c. 490–470 B.C. Tarquinia, Museo Nazionale Tarquiniense RC6846. ARV 369, 4. CVA Italia 25 Tarquinia, Museo Nazionale Tarquiniense 1 (III.I), pl. 5.1–2. CVA online vase #203903.

R-96 (1) Arming scene: Seated youth tying sandal, woman holding helmet, and corselet on a stool. Athenian red-figure stemless cup. Follower of Makron (Beazley). c. 490–470 B.C. London, British Museum E124 (GR 1873,0820.378). ARV 813, 94. CVA online vase #210076.

R-97 (1) Running warrior. Interior of Athenian red-figure cup (Type B). The Dokimasia Painter. c. 480 B.C. St. Petersburg, State Hermitage Museum 653 (ST879). ARV 413, 23. CVA Russia 12 Hermitage 5, pls. 38.2, 39.1. CVA online vase #204505.

R-98 (2) **2 Scale**. Battle scene. Athenian red-figure cup. Douris. Vulci. c. 480 B.C. Berlin, Antikensammlung F2288 (Schloss Charlottenburg F2288). ARV 438, 130. CVA Deutschland 21 Berlin, Antiquarium 2, pl. 82.2; CVA Deutschland 22 Berlin, Antiquarium 3, pl. 127.3. CVA online vase #205176.

R-99 (2) Fighting hoplites. Athenian red-figure cup interior. Douris (signed). Cerveteri. c. 480 B.C. Berlin, Antikensammlung F2287 (Schloss Charlottenburg F2287). ARV 433, 68. CVA Deutschland 21 Berlin, Antiquarium 2, pl. 79.1. CVA online vase #205114.

R-100 (1) Warrior holding shield. Athenian red-figure belly amphora (Type C). The Flying-Angel Painter. Cerveteri. c. 480 B.C. Vienna, Kunsthistorisches Museum 3724. ARV 280, 9. CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 52.2. CVA online vase #202712.

R-101 (1) Warrior with dolphins on shield. Athenian red-figure belly amphora (Type C). The Flying-Angel Painter. c. 480 B.C. Munich, Antikensammlungen 8726. ARV 280, 8. CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pl. 189.1. CVA online vase #202704.

R-102 (4) Aeneas fighting Diomedes; Herakles fighting Kyknos (all named). Athenian red-figure cup (Type B or C). The Kleophrades Painter. Camiros, Rhodes. c. 480 B.C. London, British Museum E73 (1864.10-7.1685). ARV 192, 106. CVA Great Britain 17 London, British Museum 9, pl. 83A–D. CVA online vase #201754.

R-103 (2) Ajax and Hektor led away by Phoinix and Priam. Athenian red-figure belly amphora (Type A). The Kleophrades Painter. Vulci. c. 480 B.C. Würzburg, Universität, Martin von Wagner Museum L508 (HA119). ARV 182, 5. CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pls. 12.1–2, 13.2–3. CVA online vase #201658.

R-104 (4) **2 Scale**. Greek warriors in the fields of Troy; Achilles and Ajax playing a game. Athenian red-figure cup. Makron, painter; Hieron, potter (signed). c. 480 B.C. New York, Metropolitan Museum of Art 1973.175.5 (formerly Florence, Museo Archeologico Etrusco 3929). ARV 460, 15 and ARV 481, Florence 3929. CVA Italia 30 Firenze, Museo Archeologico 3 (III.I), pl. 95.1, 95.3–4. CVA online vase #204696.

R-105 (3) **1 Scale**. Warriors arming (one cutting his hair) and departing with chariot. Athenian red-figure cup. Makron. Capua. c. 480 B.C. Paris, Musée du Louvre G271. ARV 461, 33. CVA online vase #204715.

R-106 (7) **2 Scale**. Two warriors (Odysseus and Diomedes?), and Greek and Persian warriors fighting. Interior and exterior of Athenian red-figure cup (known as "The Oxford Brygos Cup"). The Painter of the Oxford Brygos; Brygos, potter (signed). Cerveteri. c. 480 B.C. Oxford, Ashmolean Museum 1911.615. ARV 398, 9 and ARV 399, Oxford 1911.615. CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pl. 2.1; CVA Great Britain 9 Oxford, Ashmolean Museum 2 (III.I), pl. 61.2–3. CVA online vase #204329.

R-107 (1) Arming scene (line drawing of lost Athenian red-figure cup). Manner of the Painter of the Oxford Brygos. c. 480 B.C. ARV 399, Roman Market (Basseggio). In Sekunda (2002), 44 (drawing). CVA online vase #204336.

R-108 (2) Athena and old man between two warriors. Athenian red-figure amphora (Type A). The Syleus Painter. Paestum. c. 480 B.C. Kansas City, Missouri, Nelson-Atkins Museum of Art 30.13. ARV 249, 1. CVA online vase #202480.

R-109 (12) Athena and Poseidon fight giants (above); Centauromachy (below). Athenian red-figure pointed amphora. The Syleus Painter. Vulci. c. 480 B.C. Brussels, Musées Royaux R303. ARV 249, 6. CVA Belgique 1, Bruxelles, Musées Royaux du Cinquantenaire (III.I.c), pls. 8a–d, 9b. Pl. 196 in Boardman (1975). CVA online vase #202485.

R-110 (1) Gigantomachy: Herakles killing Kyknos. Athenian red-figure pelike. The Syleus Painter. Etruria. c. 480 B.C. Paris, Musée du Louvre G228. ARV 250, 14. CVA France 9 Louvre 6 (III.I.c), pl. 45.2, 45.8. CVA online vase #202517.

R-111 (1) Herakles fighting the Hydra (Iolaüs in Type IV). Athenian red-figure stamnos. The Syleus Painter. Chiusi. c. 480 B.C. Palermo, Museo Archeologico Regionale V763 (1493). ARV 251, 34. CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 31.2, 31.4. Pl. 198.2 in Boardman (1975). CVA online vase #202487.

R-112 (1) Menelaos pursuing Helen. Athenian red-figure hydria. The Syriskos Painter. Vulci. c. 480 B.C. London, British Museum E161. ARV 262, 41. CVA Great Britain 7 London, British Museum 5 (III.I.c), pl. 71.1. CVA online vase #202723.

R-113 (4) **4 Scale**. Diomedes fighting Aeneas, and Achilles and Memnon fighting over the body of Melanippos. Athenian red-figure calyx-krater. The Tyszkiewicz Painter. Vulci. c. 480 B.C. Boston, Museum of Fine Arts 97.368. ARV 290, 1. Fig. 186 (drawing) in Boardman (1975). CVA online vase #202631.

R-114 (2) Gigantomachy: Dionysos fighting giants. Athenian red-figure stamnos. The Tyszkiewicz Painter. Vulci. c. 480 B.C. London, British Museum E443. ARV 292, 29. CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 21.3a–b. CVA online vase #203003.

R-115 (1) Menelaos and Helen. Athenian red-figure hydria. The Tyszkiewicz Painter. c. 480 B.C. Munich, Antikensammlungen 2425 (J283). ARV 294, 65. CVA Deutschland 20 München, Museum Antiker Kleinkunst 5, pl. 230.1. CVA online vase #203039.

R-116 (2) Odysseus, Athena, and Diomedes. Athenian red-figure belly amphora (Type B). The Tyszkiewicz Painter. c. 480 B.C. Stockholm, Medelhavsmuseet 1963.1. ARV 1643, 33 bis. Pl. 185 in Boardman (1975). CVA online vase #275163.

R-117 (1) Warrior. Athenian red-figure neck-amphora fragments. The Berlin Painter. Orvieto. c. 480–470 B.C. Vienna, Universität 631e and Florence, Museo Archeologico Etrusco 14B4. ARV 200, 42. CVA Deutschland 5 Wien, Universität 1, pl. 13.1; CVA Italia 8 Firenze, Museo Archeologico Etrusco 1 (III.I), pl. 14.4. CVA online vase #201850.

R-118 (1) **1 Scale**. Warrior and woman running (perhaps Menelaus chasing Helen?). Athenian red-figure tripod-pyxis. Douris. Athens. c. 480–470 B.C. Mannheim, Reiss-Engelhorn-Museen 124 (Reiss-Museum 124). ARV 447, 276. CVA Deutschland 13 Mannheim, Reiss-Engelhorn-Museen (ehemals Reiss-Museum) 1, pl. 26.6; CVA Deutschland 75 Mannheim, Reiss-Engelhorn-Museen (ehemals Reiss-Museum) 2, pl. 26.6. CVA online vase #205324.

R-119 (1) Warrior. Red-figure neck-amphora (Nolan amphora with triple handles). The Oionokles Painter. Capua. c. 480–470 B.C. Capua, Museo Campano 7552 (P8). ARV 646, 8. CVA Italia 23 Capua, Museo Campano 2 (III.I), pl. 2.1, 2.3. CVA online vase #207520.

R-120 (1) Odysseus, who just won Achilles's armor, offered sash by youth. Athenian red-figure cup (Type C). The Painter of Louvre G265. Vulci. c. 480–470 B.C. Leiden, Rijksmuseum van Oudheden PC 75. ARV 416, 7. CVA The Netherlands 7 Leiden, Rijksmuseum van Oudheden 4 (III.I), pl. 164.2. CVA online vase #204538.

R-121 (2) Hoplite spearing Persian warrior holding bow and sword. Athenian red-figure neck-amphora. The Painter of the Yale Oinochoe (Beazley). Rhodes (?). c. 480–460 B.C. New York, Metropolitan Museum of Art 06.1021.117. ARV 1656. Pl. 46 in Snodgrass (1999). CVA online vase #275257.

R-122 (1) Warrior. Athenian red-figure loutrophoros fragment. The Kleophrades Painter (Bohr). c. 475 B.C. Tübingen, Eberhard-Karls-Universität, Archäologisches Institut E89 (S101667). CVA Deutschland 52 Tübingen, Antikensammlung des Archäologischen Instituts der Universität 4, pl. 8.3. CVA online vase #11738.

R-123 (1) **1 Scale**. Gigantomachy. Athenian red-figure volute-krater. The Altamura Painter. Altamura, Italy. c. 475–450 B.C. London, British Museum E469. ARV 589, 1. Pl. 10 in Boardman (1989). CVA online vase #207137.

R-124 (1) **1 Scale**. Menelaos drops his sword, dazzled by Helen's beauty (or, Menelaos pursuing Helen). Athenian red-figure amphora (Type B). The Altamura Painter. Vulci. c. 475–450 B.C. London, British Museum E263. ARV 594, 54. CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 6.2a. CVA online vase #206878.

R-125 (2) Philoctetes bitten by serpent; combat of Achilles and Memnon in the presence of Athena. Athenian red-figure calyx-krater. The Altamura Painter. Agrigento. c. 475–450 B.C. Paris, Musée du Louvre G342. ARV 590, 12. CVA France 2 Louvre 2 (III.I.d), pl. 4.2–3. CVA online vase #206830.

R-126 (3) Amazonomachy. Fragmentary Athenian red-figure cup. The Amphitrite Painter (formerly known as the Amymone Painter). Orvieto. c. 475–450 B.C. Bryn Mawr, PA, Bryn Mawr College P218. ARV 830, 2. CVA USA 13 Bryn Mawr College, The Ella Riegel Memorial Museum 1 (III.I), pl. 24.1–3. Pl. 80.5a–b in von Bothmer (1957). CVA online vase #210313.

R-127 (1) **1 Arming**. Warrior arming. Athenian red-figure cup fragment. The Amphitrite Painter (von Bothmer). c. 475–450 B.C. Karlsruhe, Badisches Landesmuseum 69.35d. CVA Deutschland 60 Karlsruhe, Badisches Landesmuseum 3, pl. 34.9. CVA online vase #32519.

R-128 (1) Amazons. Athenian red-figure neck-amphora. Related to the Charmides Painter. c. 475–450 B.C. London, British Museum E295. ARV 654, 3. CVA Great Britain 7 London, British Museum 5 (III.I.c), pl. 50.2a. (In the plate section it is actually designated as 50.1b, but in the text, it is referred to as plate 50.2a.) Pl. 86.5a in von Bothmer (1957). CVA online vase #207626.

R-129 (2) Warriors fighting. Athenian red-figure cup. The Pistoxenos Painter. c. 475–450 B.C. Vienna, Kunsthistorisches Museum 4436. ARV 1672, 5 bis. CVA Österreich 3 Wien, Kunsthistorisches Museum 3 (III.I), pl. 150.3. CVA online vase #275390.

R-130 (1) Arming scene/departure of warrior. Athenian red-figure pelike. Cerveteri. c. 475–450 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 46942. CVA Italia 64 Roma, Museo Nazionale Etrusco di Villa Giulia 4, pl. 23.1. CVA online vase #17982.

R-131 (1) **1 Scale**. Agamemnon flanked by Nestor and Thersites. Athenian red-figure hydria. London, British Museum E196. Eretria. c. 475–440 B.C. CVA Great Britain 7 British Museum 5 (III.I.c), pl. 81.1. CVA online vase #7179.

R-132 (2) Warrior with star on shield. Athenian red-figure neck-amphora (Nolan amphora with triple handles). The Achilles Painter. Nola, Italy. c. 475–425 B.C. Berlin, Antikensammlung F2332 (Berlin, Schloss Charlottenburg F2332). ARV 988, 20. CVA online vase #213841.

R-133 (5) **2 Scale.** Herakles fighting Amazons. Athenian red-figure stamnos. The Altamura Painter. Orvieto. c. 475–425 B.C. St. Petersburg, Hermitage State Museum 807. ARV 593, 42. Pl. 70.5a–b in von Bothmer (1957). CVA online vase #206866.

R-134 (1) **1 Scale**. Zeus fighting the giant Porphyrion (named). Athenian red-figure bell-krater with lugs. The Altamura Painter. c. 475–425 B.C. Paris, Musée du Petit Palais 868. ARV 592, 36. CVA France 15 Paris, Musée du Petit Palais, pl. 23.1. CVA online vase #206859.

R-135 (2) Amazonomachy. Athenian red-figure column-krater. The Ariana Painter (Beazley). c. 475–425 B.C. Geneva, Musée d'Art et d'Histoire 14990. ARV 1101, 2. CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pl. 16.5. Pl. 78.4 in von Bothmer (1957). CVA online vase #216135.

R-136 (1+) Amazonomachy. Athenian red-figure column-krater. The Ariana Painter. c. 475–425 B.C. Munich, Antikensammlungen 2376 (A929). ARV 1101, 1. Pl. 78.3 in von Bothmer (1957). CVA online vase #216134.

R-137 (1) Amazonomachy. Athenian red-figure stamnos. The Christie Painter. Orvieto. c. 475–425 B.C. Copenhagen, Ny Carlsberg Glyptothek 2694. ARV 1048, 36. Pl. 78.1 in von Bothmer (1957). CVA online vase #213605.

R-138 (1) Greek warriors and Amazon (perhaps Theseus, Peirithoos, and Antiope). Athenian red-figure pelike. The Christie Painter. Vulci. c. 475–425 B.C. Brussels, Musées Royaux A133. ARV 1048, 39. CVA Belgique 1 Brussels, Musées Royaux du Cinquantenaire (III.I.d), pl. 1.1a. CVA online vase #213608.

R-139 (1) Amphiaraos leaving home. Athenian red-figure bell-krater. The Danae Painter. Camarina, Sicily. c. 475–425 B.C. Syracuse, Museo Archeologico Regionale Paolo Orsi 18421. ARV 1075, 7. CVA Italia 17 Siracusa, Museo Archeologico Nazionale 1 (III.I), pl. 17.2. CVA online vase #214462.

R-140 (1) **1 Scale**. Departure of Amphiaraos (named) for war against Thebes. Athenian red-figure hydria. The Dwarf Painter.

c. 475–425 B.C. Boston, Museum of Fine Arts 03.798. ARV 1011, 16. Pl. 11 in Henle (1973). CVA online vase #214154.

R-141 (1) Amazonomachy. Athenian red-figure bell-krater. The Guglielmi Painter. Sant'Agata de' Goti. c. 475–425 B.C. Naples, Museo Archeologico Nazionale H1768 (M1323) (81512). ARV 1043, 3. Pl. 77.4 in von Bothmer (1957). CVA online vase #213545.

R-142 (1) Achilles and Ajax playing game, and Athena with Nike. Athenian red-figure column-krater. The Hephaistos Painter. Gela, Sicily. c. 475–425 B.C. Berlin, Antikensammlung 3199 (Pergamonmuseum 3199). ARV 1114, 9. Pl. 200 in Boardman (1989). CVA online vase #214735.

R-143 (1) **1 Scale**. Athena driving the chariot of a hoplite leaving for battle. Athenian red-figure calyx-krater. The Niobid Painter. c. 475–425 B.C. Paris, Musée du Louvre G165. ARV 601, 21. CVA France 2 Paris, Musée du Louvre 2 (III.I.c), pl. 23.1, 23.6. CVA online vase #206952.

R-144 (1) **1 Scale**. Scythian archer with axe and pelta. Athenian red-figure neck-amphora (Nolan amphora with triple handles). The Oionokles Painter. c. 475–425 B.C. Berlin, Antikensammlung F2331 (Pergamonmuseum F2331). ARV 646, 7. Pl. 360 in Boardman (1975). CVA online vase #207519.

R-145 (1) **1 Scale**. Departing warrior with Nike pouring a libation. Athenian red-figure neck-amphora (Nolan amphora with twisted handles). The Painter of the Berlin Hydria. Vulci. c. 475–425 B.C. London, British Museum E275. ARV 616, 6. CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 14.1a. CVA online vase #207126.

R-146 (1) **1 Scale**. Amazons fighting Greeks. Athenian red-figure bell-krater. The Painter of the Louvre Centauromachy. c. 475–425 B.C. Warsaw, National Museum 142357 (formerly Goluchow, Musée Czartoryski 54). ARV 1091, 51. CVA Pologne 1 Goluchow, Musée Czartoryski (III.I.d), pl. 25c. CVA online vase #215493.

R-147 (2) **1 Arming**. Warrior putting on corselet; warriors departing. Athenian red-figure cup. The Painter of Louvre G 456. c. 475–425 B.C. Havana, Museo Nacional de Bellas Artes 212. ARV 825, 9. CVA online vase #210226.

R-148 (2) **2 Horseback**. Amazons, some on horseback. Athenian red-figure bell-krater. Polygnotos. Spina. c. 475–425 B.C. Ferrara, Museo Nazionale di Spina 3089 (T411A). Pl. 83.7 in von Bothmer (1957). CVA online vase #213403.

R-149 (3) **1 Horseback**. Attic heroes (Theseus, Peirithoos, Akamas, Phorbas, etc.) fighting Amazons. Athenian red-figure dinos. The Group of Polygnotos. Agrigento, Sicily. c. 475–425 B.C. London, British Museum 99.7-21.5. ARV 1052, 29. CVA Great Britain 8 London, British Museum 6 (III.I.c), pl. 103.1b. Pl. 77.2 in von Bothmer (1957). CVA online vase #213658.

R-150 (2) Achilles fighting Hektor, with Hera watching. Athenian red-figure stamnos. The Providence Painter. Ampurias, Spain. c. 475–425 B.C. Barcelona, Museo Arqueológico 589. ARV 639, 55. CVA Espagne 3 Barcelona, Musée Archeologique 1 (III.I), pl. 18.1a. CVA online vase #207406.

R-151 (1) Libation scene of warrior leaving home. Athenian red-figure lekythos. The Providence Painter. Gela, Sicily. c. 475–425 B.C. Palermo, Mormino Collection V674. ARV 640, 67. CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 21.5. CVA online vase #207418.

R-152 (1) **1 Carried**. Woman running with corselet. Athenian red-figure lekythos. The Providence Painter. Gela, Sicily. c. 475–425

B.C. Palermo, Mormino Collection V676. ARV 641, 83. CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 21.6. Pl. 358 in Boardman (1975). CVA online vase #207435.

R-153 (1) Nike drilling hole in tree to hang shield on tropaion. Athenian red-figure pelike. The Trophy Painter (name vase). c. 475–425 B.C. Boston, Museum of Fine Arts 20.187. ARV 857, 2. Pl. 54 in Boardman (1989). CVA online vase #212473.

R-154 (4) **1 Arming**. Arming scene; fight. Athenian red-figure cup. The Akestorides Painter (Guy), Onesimos (Murray), or in the manner of Douris (Beazley). Vulci. c. 470 B.C. London, British Museum E60 (GR 1843.11-3.10). ARV 449, 7. CVA Great Britain 17 London, British Museum 9, pl. 44a–b. CVA online vase #205341.

R-155 (1) **1 Scale**. Orestes killing Aigisthos, with Clytemnestra and Electra approaching. Athenian red-figure stamnos. The Copenhagen Painter. Vulci. c. 470 B.C. Berlin F2184 (lost). ARV 257, 6. Pl. 354 (drawing) in Carpenter (1991). CVA online vase #202912.

R-156 (1) Orestes killing Aigisthos, as Clytemnestra wields an axe. Athenian red-figure calyx-krater. The Dokimasia Painter. c. 470 B.C. Boston, Museum of Fine Arts 63.1246. Pl. 274.2 in Boardman (1975). Fig. 351A in Carpenter (1991). CVA online vase #275233.

R-157 (2) **1 Arming, 1 Scale**. Arming scene; women spinning. Athenian red-figure cup. The Oedipus Painter. c. 470 B.C. New York Market, Christie's XXXX205374 (formerly Warsaw, National Museum 205374; originally Basel Market, Borowski). ARV 451, 3. CVA online vase #205374.

R-158 (2) Two Persians, one riding a mule side-saddle. Athenian red-figure oinochoe. The Painter of the Brussels Oinochoai. Cerveteri. c. 470 B.C. London, British Museum 1912.7-9.1. ARV 775, 1. In Sekunda (1992), 52.

R-159 (8) **2 Horseback**. Warrior in Type IV with youth; fight with foot-soldiers and cavalry. Interior and exterior of Athenian red-figure cup. The Pistoxenos Painter. Vulci. c. 470 B.C. Berlin, Antikensammlung 4982.19 (formerly Schloss Charlottenburg 4982.19). ARV 860, 5. CVA Deutschland 22 Berlin, Antiquarium 3, pls. 104.1–4, 105.1, 131.3. CVA online vase #211328.

R-160 (1) Warrior confronting old man with staff (Death of Priam?). Athenian red-figure cup. The Telephos Painter. Orvieto. c. 470 B.C. St. Petersburg, State Hermitage Museum 658. ARV 817, 3. CVA Russia 12 Hermitage 5, pls. 57.2, 58.2–3. CVA online vase #210103.

R-161 (1) Warrior. Athenian red-figure lekythos. The Tithonos Painter. Eretria. c. 470 B.C. Athens, National Museum 1644 (CC1393). ARV 310, 19. CVA online vase #203189.

R-162 (1) Lapiths (Kaineus) fighting centaurs. Athenian red-figure hydria (kalpis type). The Leningrad Painter. Capua. c. 470–460 B.C. London, British Museum 1920.3-15.3. ARV 571, 79. CVA Great Britain 7 British Museum 5 (III.I.c), pl. 73.2. Pl. 326 in Boardman (1975). CVA online vase #206571.

R-163 (3) **3 Scale**. Iliupersis (Sack of Troy): Neoptolemos uses body of Astyanax to batter Priam; Ajax assaults Cassandra. Athenian red-figure volute-krater. The Niobid Painter. Bologna. c. 470–460 B.C. Bologna, Museo Civico Archeologico 268 (18108). ARV 598, 1. CVA Italia 33 Bologna, Museo Civico 5 (III.I), pls. 99.3, 100.1–3. CVA online vase #206929.

R-164 (4) **1 Arming**. Warriors arming. Interior and exterior of Athenian red-figure cup (Type C). The Telephos Painter. c. 470–460

B.C. Frankfurt am Main, Städel Institut STV9. ARV 818, 16. CVA Deutschland 30 Frankfurt am Main 2, pl. 63.2, 63.4–5. CVA online vase #210116.

R-165 (1) **1 Horseback/Scale**. Amazonomachy. Athenian red-figure volute-krater. The Niobid Painter. Ruvo, Italy. c. 470–450 B.C. Naples, Museo Archeologico Nazionale H2421 (81672) (M1483). ARV 600, 13. Pl. 74.4 in von Bothmer (1957). CVA online vase #206941.

R-166 (2) **2 Scale**. Two warriors leaving home, with chariot, and combat of two warriors in presence of Nike. Athenian red-figure volute-krater. The Niobid Painter. Etruria. c. 470–450 B.C. Paris, Musée du Louvre G343. ARV 600, 17. CVA France 4 Louvre 3 (III.I.d), pls. 5.3, 6.3. CVA online vase #206948.

R-167 (3) **1 Scale**. Iliupersis: Neoptolemos uses body of Astyanax to batter Priam. Athenian red-figure calyx-krater. The Altamura Painter. c. 465 B.C. Boston, Museum of Fine Arts 59.176. ARV 590, 11. Pl. 102 in Woodford (1993). CVA online vase #206829.

R-168 (1) Gigantomachy: Dionysos and maenad attacking giant. Athenian red-figure calyx-krater. The Blenheim Painter. Bologna. c. 465 B.C. Bologna, Museo Civico Archeologico 286. ARV 598, 3. CVA Italia 27 Bologna, Museo Civico 4 (III.I), pl. 76.3. CVA online vase #206925.

R-169 (1) Helen fleeing from Menelaos. Athenian red-figure column-krater. Circle of the Leningrad Painter (CVA) or Early Mannerist (Beazley). c. 460 B.C. Tübingen, Eberhard-Karls-Universität, Archäologisches Institut 67.5806. ARV 585, 27. CVA Deutschland 52 Tübingen, Antikensammlung des Archäologischen Instituts der Universität 4, pl. 16.2, 16.5–6. CVA online vase #206757.

R-170 (1) Warrior. Athenian red-figure skyphos. The Lewis Painter. Phocis. c. 460 B.C. Athens, National Museum 1421 (CC1356). ARV 973, 12. CVA online vase #213246.

R-171 (1) Theseus (named) leaving home. Athenian red-figure calyx-krater. The Methyse Painter. Vulci. c. 460 B.C. Bologna, Museo Civico Archeologico PU285. ARV 633, 6. CVA Italia 27 Bologna, Museo Civico 4 (III.I), pl. 78.3. CVA online vase #207341.

R-172 (1) **1 Scale**. Gigantomachy (with Poseidon fighting giant in Type IV). Athenian red-figure calyx-krater. The Niobid Painter. Spina. c. 460 B.C. Ferrara, Museo Nazionale di Spina 2891 (T313). ARV 602, 24. CVA Italia 37 Ferrara, Museo Nazionale 1, pls. 17.1, 18.1. Pl. 6 in Boardman (1989). CVA online vase #206956.

R-173 (1) **1 Scale**. Warrior leaving home. Athenian red-figure volute-krater. Manner of the Niobid Painter. Spina. c. 460 B.C. Ferrara, Museo Nazionale di Spina T113AVP. ARV 608, 3. CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 8.1. CVA online vase #207046.

R-174 (4) Greeks fighting Persians. Interior and exterior of Athenian red-figure cup. The Triptolemos Painter. Italy. c. 460 B.C. Edinburgh, National Museums of Scotland 1887.213. ARV 364, 46. CVA Great Britain 16 Edinburgh, The National Museums of Scotland, pls. 23.7–8, 24.1–4. Pls. 303.1–2 in Boardman (1975). CVA online vase #203838.

R-175 (4) **1 Horseback/Scale, 2 Foot/Scale**. Amazonomachy. Athenian red-figure volute-krater (known as "The Gela Krater"). The Niobid Painter. Gela, Sicily. c. 460 B.C. Agrigento, Museo Archeologico Regionale 2688 (formerly Palermo, Museo Archeologico Regionale G1283). ARV 599, 2. Pls. 176, 178, 179, 181 in Arias (1962). Pl. 74.3 in von Bothmer (1957). CVA online vase #206930.

R-176 (2) Greek warrior spearing Persian warrior, and Persian warrior running (Persians in Type IV). Athenian red-figure calyx-krater. c. 460 B.C. Basel, Antikenmuseum und Sammlung Ludwig BS480. CVA Schweiz 7 Basel, Antikenmuseum und Sammlung Ludwig 3 (III.I), pls. 8.3–4, 9.3–4. CVA online vase #1287.

R-177 (1) Warrior arming, with helmet and shield. Interior of Athenian red-figure cup (Type B). Capua. c. 460 B.C. Berlin, Antikensammlung 3241 (F38). CVA Deutschland 21 Berlin, Antiquarium 2, pl. 94.3; CVA Deutschland 22 Berlin, Antiquarium 3, pl. 129.8. CVA online vase #1003937.

R-178 (2) **1 Scale**. Warriors departing, and Menelaos and Helen. Athenian red-figure volute-krater. The Niobid Painter. Bologna. c. 460–455 B.C. Bologna, Museo Civico Archeologico 269 (17190). ARV 599, 8. CVA Italia 33 Bologna, Museo Civico 5 (III.I), pl. 102.1–2. CVA online vase #206936.

R-179 (4) Battle scene. Athenian red-figure cup. The Sabouroff Painter. Tarquinia. c. 460–450 B.C. Tarquinia, Museo Nazionale Tarquiniense RC2072. ARV 837, 2. CVA Italia 26 Museo Nazionale Tarquiniense 2 (III.I), pl. 19.2–3. CVA online vase #212181.

R-180 (1) **1 Scale.** Warrior leaving home. Athenian red-figure neck-amphora (Nolan amphora with ridged handles). The Sabouroff Painter. Lipona. c. 460–450 B.C. Munich, Antikensammlungen 2342A (J381). ARV 842, 118. CVA Deutschland 6 München, Museum Antiker Kleinkunst 2 (III.I), pl. 58.2. CVA online vase #212266.

R-181 (1) Warrior with sword (Theseus?) pursuing a woman (Type of Menelaos pursuing Helen). Athenian red-figure neck-amphora (Nolan amphora with ridged handles). The Sabouroff Painter (Beazley). c. 460–450 B.C. London, British Museum E333. ARV 842, 116. CVA Great Britain 7 British Museum 5 (III.I.c), pl. 64.2a. CVA online vase #212264.

R-182 (1) Achilles. Athenian red-figure amphora (Type B). The Achilles Painter (name vase). Vulci. c. 460–440 B.C. Vatican City, Museo Gregoriano Etrusco Vaticano 16571. ARV 987, 1. Pl. 109 in Boardman (1989). CVA online vase #213821.

R-183 (1) **1 Arming**. Group scene of warriors arming. Athenian red-figure cup. The Euaion Painter. Etruria. c. 460–440 B.C. Bologna, Museo Civico Archeologico PU274. ARV 793, 78. CVA Italia 5 Bologna, Museo Civico 1 (III.I.c), pls. 16.1, 17.1. CVA online vase #209786.

R-184 (1) **1 Arming**. Youth arming, with woman holding his shield and helmet. Athenian red-figure lekythos. The Phiale Painter. c. 460–425 B.C. Palermo, Museo Archeologico Regionale 2564. ARV 1021, 115. CVA online vase #214296.

R-185 (1) **1 Scale**. Greek killing Amazon (probably Achilles killing Penthesilia). Interior of Athenian red-figure cup. The Penthesilia Painter (name cup). Vulci. c. 455 B.C. Munich, Antikensammlungen 2688 (J370) (8705). ARV 879, 1. Pl. 80.1 in Boardman (1989). CVA online vase #211565.

R-186 (1) Warrior and draped man holding spear. Athenian red-figure bell-krater. The Achilles Painter. c. 450 B.C. New York, Metropolitan Museum of Art 07.286.81. ARV 991, 61. Fig. 114 in Boardman (1989). CVA online vase #213882.

R-187 (1) Warrior with dog leaving home, between draped man and woman holding oinochoe. Athenian red-figure stamnos. The Achilles Painter. Vulci. c. 450 B.C. London, British Museum E448. ARV 992, 65. CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a. Pl. 115 in Boardman (1989). CVA online vase #213886.

R-188 (1) Punishment of Ixion: Ares (in Type IV) and Hermes present Ixion to Hera, while Athena holds the winged wheel. Athenian red-figure kantharos (Type A). The Amphitrite Painter (formerly known as the Amymone Painter). Nola, Italy. c. 450 B.C. London, British Museum E155 (1865.1-3.23). ARV 832, 37. CVA Great Britain 5 British Museum 4 (III.I.c), pl. 35.2b-2c. Fig. 132 in Carpenter (1991). CVA online vase #212127.

R-189 (2) Eurytus, king of Oechalia, with two archers. Applied red technique Etruscan stamnos imitating Athenian red-figure (used as cinerary urn). The Bargagli Painter. Sarteano, Italy. c. 450 B.C. Siena, Museum of Archaeology, inv. B304. In Goring (2004), 127.

R-190 (8) **1 Horseback/Scale, 3 Foot/Scale**. Amazonomachy. Athenian red-figure calyx-krater. The Geneva Painter. c. 450 B.C. Geneva, Musée d'Art et d'Histoire MF238. ARV 615, 1. CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pls. 14.1–4, 16.1–3. Fig. 17 (drawing) in Boardman (1989). CVA online vase #207115.

R-191 (1) **1 Scale**. Apollo directs arrow shot by Paris at Achilles's (in Type IV) heel. Athenian red-figure pelike. The Niobid Painter. c. 450 B.C. Bochum, Ruhr-Universität, Kunstsammlungen S1060. CVA Deutschland 81 Bochum, Kunstsammlungen der Ruhr-Universität 2, pls. 4.1, 5.2. Fig. 8 in Boardman (1989). CVA online vase #6974.

R-192 (3) **2 Scale**. Amazonomachy. Athenian red-figure calyx-krater. The Painter of the Berlin Hydria. Numana, Italy. c. 450 B.C. New York, Metropolitan Museum of Art, 07.286.86. ARV 616, 3. Pl. 141 in Boardman et al. (1967). Pl. 74.2 in von Bothmer (1957). CVA online vase #207122.

R-193 (7) Amazonomachy. Athenian red-figure volute-krater. The Painter of Bologna 279. c. 450 B.C. Basel, Antikenmuseum und Sammlung Ludwig BS486. ARV 612, 2. CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4. Pl. 16 in Boardman (1989). CVA online vase #207096.

R-194 (7) **6 Scale**. Amazonomachy. Athenian red-figure volute-krater (name vase). The Painter of Bologna 279. Bologna. c. 450 B.C. Bologna, Museo Civico Archeologico 279. ARV 612, 3. CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 63.5, 64.7–8, 65.9–10, 66.12. CVA online vase #207097.

R-195 (1) Warrior carrying shield. Attic red-figure neck-amphora. Manner of the Painter of London E 342. c. 450 B.C. Formerly in the Gallatin Collection; now at the Metropolitan Museum of Art, New York 41.162.131. ARV 670, 7. CVA USA 8 Fogg Museum and Gallatin Collections (Gallatin Coll. III.I), pl. 54.2a.

R-196 (1) Warrior leaving home. Athenian red-figure neck-amphora. The Painter of the Louvre Centauromachy. c. 450 B.C. Warsaw, National Museum 147367 (Wilanow, Palace Museum 5406). ARV 1683, 90 bis. CVA Pologne 6 Varsovie, Musée National 3 (III.I), pl. 14. CVA online vase #275459.

R-197 (1) Kadmos and the dragon, with Athena and Ares (in Type IV). Athenian red-figure calyx-krater. The Spreckels Painter. Agrigento, Sicily. c. 450 B.C. New York, Metropolitan Museum of Art 1907.286.663. ARV 617, 2. Pl. 19 in Boardman (1989). CVA online vase #207136.

R-198 (1) Centauromachy. Athenian red-figure stemless cup. Athens. c. 450 B.C. Kiel, Antikensammlung B52. CVA Deutschland 55 Kiel, Kunsthalle, Antikensammlung 1, pl. 50.5, 50.7. CVA online vase #30082.

R-199 (1) Departure of warrior. Athenian red-figure lekythos. Eretria. c. 450 B.C. Athens, National Museum 1295. CVA online vase #2572.

R-200 (6+) Ajax defending the Greek ships from Trojan warriors. Etruscan vase imitating an Attic red-figure amphora. c. 450 B.C. Munich, Museum Antiker Kleinkunst (now Antikensammlungen) 3171 (J890). In Sekunda (2002), 73. Pl. 249.1–2 in Giglioli (1935).

R-201 (1) Scene in Hades: Hades, Peirithoos, Theseus (in Type IV), Herakles, and Hermes. Athenian red-figure calyx-krater. The Nekyia Painter (name vase). c. 450–440 B.C. New York, Metropolitan Museum of Art 08.258.21. ARV 1086, 1. Pl. 184 in Boardman (1989). CVA online vase #214585.

R-202 (2) **2 Scale**. Iliupersis: Neoptolemos threatens Priam, and scenes from Trojan War. Athenian red-figure calyx-krater. The Niobid Painter. Spina. c. 450–440 B.C. Ferrara, Museo Nazionale di Spina 2895 (T936). ARV 601, 18. CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 16.1–2. CVA online vase #206949.

R-203 (1) Warrior receiving arms from Nike. Athenian red-figure neck-amphora (Nolan amphora with ridged handles). The Painter of the Louvre Symposion. c. 450–440 B.C. Cambridge, Fitzwilliam Museum 11.17 (GR11.1917). ARV 1070, 4. CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.I), pls. 33.1a, 40.2. CVA online vase #214410.

R-204 (2) **2 Horseback**. Amazons on horseback with spears. Athenian red-figure pelike. The Biscoe Painter. c. 450–425 B.C. Fayetteville, AR, University of Arkansas Museum 57.24.21. ARV 1063, 1. Pl. 83.4 in von Bothmer (1957). CVA online vase #213803.

R-205 (1) Amazon with bow. Athenian red-figure oinochoe. The Mannheim Painter. Orvieto. c. 450–425 B.C. Mannheim, Reiss-Museum 61. ARV 1066, 9. CVA Deutschland 13 Mannheim, Reiss-Museum 1, pls. 24.2, 25.3. Pl. 84.3a in von Bothmer (1957). CVA online vase #214364.

R-206 (2) **1 Horseback**. Amazon on horseback attacked by Greek hoplites. Athenian red-figure stamnos. The Group of Polygnotos. c. 450–425 B.C. Paris, Musée du Louvre G414. ARV 1051, 11. CVA France 4 Paris, Musée du Louvre 3 (III.I.d), pl. 19.2. CVA online vase #213642.

R-207 (1) Warrior leaving home. Athenian red-figure bell-krater. The Group of Polygnotos. c. 450–425 B.C. Vienna, Kunsthistorisches Museum 853 (Vienna, University 853). ARV 1054, 53. CVA Österreich 3 Wien, Kunsthistorisches Museum 3 (III.I), pl. 113.3. CVA online vase #213683.

R-208 (1) Warrior at gravestone. Athenian red-figure loutrophoros fragment. The Kleophon Painter. c. 450–420 B.C. Athens, National Museum 1700. ARV 1146, 50. Pl. 176 in Boardman (1989). CVA online vase #215190.

R-209 (1) Amazonomachy. Athenian red-figure neck-amphora (with twisted handles). Polygnotos. c. 450–420 B.C. London, British Museum E272. ARV 1031, 38. Pl. 81.2 in von Bothmer (1957).

R-210 (1) Amazon with axe and bow (in Type IV) and Amazon Andromache on horseback (named). Athenian red-figure kantharos. The Alexandre Group. c. 450–400 B.C. Athens, National Museum 1236 (CC1596). ARV 1213, Athens 1236. Pl. 82.1a in von Bothmer (1957). CVA online vase #216557.

R-211 (1) Combat of Theseus (named) and the Amazon Andromache. Athenian red-figure kantharos (Type A). The Alexandre Group. Camiros, Rhodes (tomb F. 56). c. 450–400 B.C. London, British Museum E157. ARV 1213, 2. CVA Great Britain 5 British Museum 4 (III.I.c), pl. 34.2a.

Pl. 225 in Boardman (1989). CVA online vase #216556.

R-212 (1) Amazon with axe and bow. Athenian red-figure neck-amphora (Nolan amphora with triple handles). The Durham Painter. c. 450–400 B.C. Madrid, Museo Arqueológico Nacional 11113 (L182). ARV 1193, 2. CVA Espagne 2 Madrid, Museo Arqueológico Nacional 2 (III.I.c), pl. 21.4a. CVA online vase #215784.

R-213 (2) Achilles and Patroklos departing. Athenian red-figure kantharos. The Eretria Painter. Vulci. c. 450–400 B.C. Paris, Cabinet des Médailles 851. ARV 1251, 41. CVA online vase #216978.

R-214 (2) Departing warrior with Nike; Amazons. Athenian red-figure kantharos. The Eretria Painter. Bologna. c. 450–400 B.C. Bologna, Museo Civico Archeologico 467. ARV 1251, 40. CVA online vase #216977.

R-215 (1) Paris and Apollo. Athenian red-figure kantharos. The Eretria Painter. Gravina, Italy. c. 450–400 B.C. Gravina, Museum 177009. CVA online vase #8063.

R-216 (1) **1 Scale.** Warrior. Athenian red-figure pottery fragment. The Eretria Painter. Ampurias, Spain. c. 450–400 B.C. Barcelona, Museo Arqueológico 532. ARV 1252, 44. CVA Espagne 3 Barcelona, Musée Archeologique 1 (III.I), pl. 28.1. CVA online vase #216981.

R-217 (1) Warrior (Iolaos). Athenian red-figure stemless cup fragment. The Eretria Painter. Naucratis, Egypt. c. 450–400 B.C. Oxford, Ashmolean Museum G138.14. ARV 1252, 49. CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pls. 14.25, 39.5, 43.13. CVA online vase #216986.

R-218 (5) **4 Foot/Scale, 1 Horseback**. Amazonomachy. Athenian red-figure calyx-krater. Circle of the Penthesilia Painter. Bologna. c. 445 B.C. Bologna, Museo Civico Archeologico 289. ARV 891, Bologna 289. CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 73.3–5, 74.7–10. Pl. 74.1 in von Bothmer (1957). CVA online vase #211752.

R-219 (1) Warrior leaving home for battle. Athenian red-figure hydria (kalpis type). Group of the Niobid Painter. c. 440 B.C. Athens, Benaki Museum 38151. CVA Greece 9 Athens, Benaki Museum 1, pls. 3.2, 4.2–3, 5.2.

R-220 (2) **1 Scale**. Gigantomachy. Athenian red-figure calyx-krater. Manner of the Niobid Painter. c. 440 B.C. Basel, Antikenmuseum und Sammlung Ludwig LU51. ARV 1661, 7 bis. Pl. 9 in Boardman (1989). CVA online vase #275292.

R-221 (1) Warrior leaving home. Athenian red-figure pelike. Manner of the Niobid Painter, or the Spreckels Painter. Vulci. c. 440 B.C. Munich, Antikensammlungen 2359 (J306). ARV 1661, Munich 2359. CVA Deutschland 6 München, Museum Antiker Kleinkunst 2 (III.I), pls. 73.1, 75.4. CVA online vase #275293.

R-222 (9) **6 Scale**. The Seven against Thebes. Athenian red-figure volute-krater. The Painter of Bologna 279. Spina. c. 440 B.C. Ferrara, Museo Nazionale di Spina 3031 (T579). ARV 612, 1. CVA Italia 37 Ferrara, Museo Nazionale 1, pls. 9.1–4, 10.1–4. Fig. 15.1–2 in Boardman (1989). CVA online vase #207095.

R-223 (1) Warrior leaving home. Athenian red-figure cup. The Painter of the Naples Hydriskai. Chiusi. c. 440 B.C. Florence, Museo Archeologico Etrusco PD372. ARV 1267, 16. CVA Italia 38 Firenze, Museo Archeologico Etrusco 4 (III.I), pl. 151.1. CVA online vase #217200.

R-224 (1) **1 Scale**. Warrior and youth wearing cloak. Red-figure oinochoe (Form 4). The

Shuvalov Painter. c. 440–435 B.C. Vienna, Kunsthistorisches Museum IV 898. ARV 1206, 7. CVA Österreich 5 Wien, Kunsthistorisches Museum 5, pl. 17.2, 17.5. CVA online vase #215964.

R-225 (4+) **1 Scale**. Gigantomachy. Athenian red-figure vase. Aison, or the Group of Polygnotos. c. 440–430 B.C. Ferrara, Museo Nazionale di Spina, inv. no. unknown. CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 21.3–4.

R-226 (2) **1 Horseback**. Combat scene (Amazonomachy?). Athenian red-figure stamnos. The Christie Painter. c. 440–430 B.C. London, British Museum 98.7-15.1. ARV 1048, 35. CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 25.1a, 25.1d, 25.1e. CVA online vase #213604.

R-227 (1) **1 Arming**. Warrior arming, while a woman holds his helmet and shield. Athenian red-figure lekythos. The Phiale Painter. Sicily. c. 440–430 B.C. London, British Museum E596 (GR 1863,0728.440). ARV 1021, 116. CVA online vase #214297.

R-228 (1) **1 Horseback/Scale**. Amazonomachy with Theseus. Athenian red-figure squat lekythos. The Eretria Painter. Athens. c. 440–410 B.C. Boston, Museum of Fine Arts 95.48. ARV 1248, 2. Fig. 230 (drawing) in Boardman (1989). Pl. 77.6 in von Bothmer (1957). CVA online vase #216938.

R-229 (4) **4 Scale**. Amazons. Interior and exterior of Athenian red-figure cup. The Eretria Painter. Nola, Italy. c. 440–410 B.C. Naples, Museo Archeologico Nazionale 81324 (H2613) (M1135). ARV 1252, 50. Pl. 85a–f in von Bothmer (1957). CVA online vase #216987.

R-230 (1) Warrior and youth with horse leaving home. Athenian red-figure cup. The Codrus Painter. Nola, Italy. c. 430 B.C. Altenburg, Staatliches Lindenau-Museum 232. ARV 1270, 14. CVA Deutschland 18 Altenburg, Staatliches Lindenau-Museum 2, pl. 70.6. CVA online vase #217223.

R-231 (1) Warrior. Athenian red-figure loutrophoros fragment. The Kleophon Painter (Bohr). c. 430 B.C. Tübingen, Eberhard-Karls-Universität, Archäologisches Institut E163 (S101568E). CVA Deutschland 52 Tübingen, Antikensammlung des Archäologischen Instituts der Universität 4, pl. 8.4. CVA online vase #11739.

R-232 (1) **1 Horseback**. Nike with warrior on horseback. Apulian style red-figure bell-krater. The Hearst Painter. c. 430–400 B.C. Lecce, Museo Provinciale Sigismondo Castromediano 574. CVA Italia 4 Lecce, Museo Provinciale 1 (IV.Dr.), pl. 4.3. CVA online vase #9002209.

R-233 (1) Amazonomachy (Theseus and Amazons). Red-figure squat lekythos. Aison. Cumae. c. 420 B.C. Naples, Museo Archeologico Nazionale RC239 (86496). ARV 1174, 6. Pl. 293 in Boardman (1989). CVA online vase #215562.

R-234 (1) **1 Scale**. Poseidon slaying giant (in Type IV), with Ge watching. Interior of Athenian red-figure cup. Aristophanes, painter (signed); Erginos, potter (signed). Vulci. c. 410–405 B.C. Berlin, Antikensammlung F2531 (Schloss Charlottenburg F2531). ARV 1318, 1. CVA Deutschland 22 Berlin, Antiquarium 3, pl. 121.4. Fig. 289.1 in Boardman (1989). CVA online vase #220533.

R-235 (1) **1 Horseback**. Poseidon rides to contend with Athena for Attica. Red-figure pelike. The Karneia Painter. Heraclea. c. 400 B.C. Policoro, Museo Nazionale della Siritide 35304 (formerly Taranto National Archaeological Museum 282). Fig. 512 in Carratelli et al. (1983). Pl. 25.3 in Trendall (1967).

R-236 (1) **1 Scale**. Warriors. Etruscan vase imitating Attic red-figure stamnos. c. 400

B.C. Hamburg, Museum für Kunst und Gewerbe 1917.658. Pl. 249.4 in Giglioli (1935).

R-237 (1) Achilles sacrificing Trojan prisoners at the tomb of Patroklos. Faliscan red-figure stamnos. Sovana, Italy. Fourth century B.C. Berlin, Altes Museum 5825. Pl. 20.2 (drawing) in Beazley (1947).

R-238 (1) Sack of Troy: Menelaos (in Type IV) pursues Helen, but Aphrodite interposes herself (lower scene). Faliscan red-figure calyx-krater. The Nazzano Painter. Civita Castellana (Falerii Veteres). c. 375–350 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 1197. CVA Italia 2 Roma, Museo Nazionale Etrusco di Villa Giulia 2 (IV.Br.), pl. 10.2. CVA online vase #9002167.

R-239 (1) Heroized warrior in shrine. Apulian funerary volute-krater. c. 350 B.C. London, British Museum (unpublished). Pl. 15 in Anderson (1970).

R-240 (1) **1 Scale**. Ajax the Lesser, attacked by Cassandra, clinging to statue of Athena. Paestan red-figure calyx-krater fragment. Asteas. c. 350–340 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Pl. 103 in Woodford (1993).

R-241 (1) Torso of warrior in Type IV. Athenian red-figure cup fragment. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. 11.204.

R-242 (1) Warrior (Amazon?) with swastikas on his epomides. Athenian red-figure vase fragment. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. 24. Pl. 79 in von Bothmer (1957).

R-243 (1) Warrior arming. Athenian red-figure cup interior fragments. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. B.2.

R-244 (1) Warrior in Type IV. Athenian red-figure cup interior fragments. CVA Italia 8 Firenze, Museo Archeologico 1 (III.I), pl. D.3.

R-245 (1) Helmeted, bearded warrior. Red-figure vase fragment. Athens, National Museum, case of fragments.

R-246 (1) Warrior and horses. Red-figure vase fragment. Athens, National Museum, case of fragments.

R-247 (2) Warriors arming. Red-figure vase fragment. Athens, National Museum, case of fragments.

R-248 (2) Warriors fighting. Red-figure vase fragment. Athens, National Museum, case of fragments.

R-249 (1) Young helmeted warrior. Red-figure vase fragment. Athens, National Museum, case of fragments.

Stone Sculptures and Reliefs

S-1 (1) Warrior mounting chariot. Lower part of shaft of Hymettian marble stele. Said to have been found in Attica. c. 535–525 B.C. New York, Metropolitan Museum of Art 36.11.13. Fig. 128 in Richter (1961).

S-2 (1) Warrior in profile (headless). Shaft of a stele. Found at Stamata (a demos of Ikaria). c. 530 B.C. Athens, National Museum 3071. Fig. 129 in Richter (1961).

S-3 (6) Battle scenes. Marble frieze reliefs from the Siphnian Treasury at Delphi. c. 525 B.C. Delphi Archaeological Museum. Fig. 309 in Carpenter (1991).

S-4 (1) Pentelic marble stele (gravestone) of Aristion (signed "The work of Aristocles" on the base). Archaic Greek relief. From Velanideza, Attica. c. 510 B.C. Athens, National Museum 29. Fig. 235 in

Boardman (1978). Figs. 155–58 in Richter (1961).

S-5 (1) Warrior in profile (above waist). Upper part of shaft of a stele. Found built into wall of Chapel of S. Andreas at Levi, in Attica. c. 510 B.C. Athens, National Museum 33. Fig. 165 in Richter (1961).

S-6 (3) Hoplite warriors and chariot. Stone relief-carved statue base, built into city wall of Athens. c. 500 B.C. Athens, National Museum 3477. Fig. 241 in Boardman (1978).

S-7 (1) Persian (king?) spearing Greek hoplite. Persian cylinder seal. c. 500–475 B.C. New York, Metropolitan Museum of Art.

S-8 (1) **1 Scale.** Marble statue of Herakles as archer, from east pediment of Temple of Aphaia on Aegina. c. 490–480 B.C. Munich, Glyptothek 84. Fig. 206.6 in Boardman (1978).

S-9 (1) Limestone metope of fighting warriors. From the Heraion at the mouth of the Sele River, Paestum. c. 480 B.C. Paestum, Museo Nazionale. Fig. 439 in Carratelli et al. (1983).

S-10 (1) Limestone torso of fighting warrior or Amazon. From the Sanctuary of Apollo Lykaios at Metapontum. c. 480 B.C. Metapontum, Antiquarium. Fig. 440 in Carratelli et al. (1983).

S-11 (1) Warrior giving helmet to seated deity. North frieze of Harpy Monument, Xanthos. (Lycian, of marble). c. 480–460 B.C. London, British Museum.

S-12 (1) Herakles fighting Amazon wearing cuirass. Limestone and marble relief, metope from Temple E at Selinus. c. 460 B.C. Palermo, Museo Archeologico Regionale. Fig. 196 in Carpenter (1991). Pl. 66.3 in von Bothmer (1957).

S-13 (3+) **3+ Horseback**. Parthenon. North frieze slabs 12 and 38, south frieze slab 13, west frieze slab 6. Athens. c. 440 B.C.

S-14 (1) Victory standing beside tropaion. Athenian monument. c. 425–400 B.C. Athens, Acropolis Museum 3173. Fig. 11 in Anderson (1970).

S-15 (1) Nike erecting trophy. Blue chalcedony scaraboid. Fourth century B.C. London, British Museum 65.7-12.86. Fig. 590 and p. 293 in Boardman (1970). Fig. 247 and p. 83 in Richter (1968).

S-16 (2+) Hoplites fighting. Part of frieze from the "Nereid Monument," from tomb at Xanthos in Lycia. c. 400 B.C. London, British Museum. Fig. 14 in Anderson (1970).

S-17 (3+) Row of hoplites advancing. Part of frieze from the "Nereid Monument," from tomb at Xanthos in Lycia. c. 400 B.C. London, British Museum. Fig. 13 in Anderson (1970).

S-18 (1) Two hoplites shield to shield. Part of frieze from the "Nereid Monument," from tomb at Xanthos in Lycia. c. 400 B.C. London, British Museum. In Hackett (1989), 78.

S-19 (1) Achaemenid cavalryman. Relief from Bozkir, southern Turkey (now lost). c. fourth century B.C. (?). Bossert (1942), no. 1122. Image in Sekunda (1992), 25.

S-20 (1) **1 Horseback.** Horseman fighting Gaul. Etruscan stele (gravestone) from the Certosa of Bologna. c. 400–375 B.C. Bologna, Museo Civico Archeologico. Pl. 3 in Goldscheider (1941).

S-21 (1) **1 Horseback**. Relief of warrior on horseback. Pelinna, Thessaly. c. 350–340 B.C. Paris, Louvre. In Sekunda (1984), 5.

S-22 (3) **3 Horseback.** Heavy cavalry attacking Greek (?) infantry. Relief from

Bursa, Turkey. c. 350–300 B.C. Bursa Museum. In Sekunda (1984), 22.

S-23 (8) **1 Horseback.** The Alexander Sarcophagus. c. 325–312 B.C. Istanbul Archaeological Museum.

S-24 (1) Type IV armor. Decorative reliefs on the Monument of Shields along the Decumanus Maximus at Dion. c. 325–300 B.C. Pl. 13 in Polito (1998).

S-25 (1) The Amazon Sarcophagus. c. 325–300 B.C. Vienna, Kunsthistorisches Museum. Pl. 19 in Ridgway (1990).

S-26 (1) Relief of arms and Type IV armor from an unknown monument. c. 300 B.C. Thasos, Archaeological Museum, inv. 1008. Pl. 14 in Polito (1998).

S-27 (2+) Stone reliefs of armor and helmets from the Hellenistic era. From the east gate of Side, Turkey. c. 150 B.C. Side, Archaeological Museum. Pl. 18 in Polito (1998).

S-28 (1+) Relief of Battle of Macedonians and Persians. Facade of Macedonian tomb, the "Great Tomb" (Tomb 18C). Lefkadia. c. third century B.C. Pls. 27a, 27b, 29a in Petsas (1966).

S-29 (2) Sacrifice of Polyxena; Sacrifice of Trojan prisoners. Etruscan peperino sarcophagus relief. Torre san Severo. c. 300 B.C. Orvieto, Museo Etrusco Faina. Pl. 347 in Giglioli (1935). Pl. 143 in Spivey (1997).

S-30 (1) **1 Horseback**. Relief of warrior on horseback. Funerary stele of Nikanor, son of Herakleides. Gephyra, Macedonia. c. 300 B.C. Kilkis Archaeological Museum 2315. In Hatzopoulos and Juhel (2009), 433, fig. 10.

S-31 (3) Battle scene. Relief on Etruscan stone sarcophagus of man reclining with a fawn at his side. From the tomb of the Pulena family, Tarquinia. End of fourth/beginning of third century B.C. Tarquinia, Museo Nazionale Tarquiniense. Pl. 250 in Sprenger and Bartoloni (1977). Fig. 166 in Spivey (1997).

S-32 (1) Warrior fighting centaur. Belevi Mausoleum, coffer (S 6). From near Ephesos. c. 300 B.C. (?) Izmir Museum. Pl. 93 in Ridgway (1990).

S-33 (1) Warrior fighting centaur. Belevi Mausoleum, coffer (S 4). From near Ephesos. c. 300 B.C. (?) Izmir Museum. Pl. 92 in Ridgway (1990).

S-34 (1) Warrior fighting centaur. Belevi Mausoleum, coffer (W 3). From near Ephesos. c. 300 B.C. (?) Izmir Museum. Pl. 90 in Ridgway (1990).

S-35 (1) Warrior fighting centaur. Belevi Mausoleum, coffer (W 4). From near Ephesos. c. 300 B.C. (?) Izmir Museum. Pl. 91 in Ridgway (1990).

S-36 (1) Warrior. Belevi Mausoleum, coffer (W 1). From near Ephesos. c. 300 B.C. (?) Izmir Museum. Pl. 94 in Ridgway (1990).

S-37 (1) **1 Horseback.** Battle metope/tomb relief. Tarentum. c. 300–250 B.C. Taranto, Museo Nazionale 113.768. Fig. 204.2 in R. Smith (1991). Fig. 533 in Carratelli et al. (1983).

S-38 (1) Duel of Eteocles and Polyneices. Relief on painted Etruscan alabaster cinerary urn with a member of the Sentinate-Cumere family on the lid. Sentinate-Cumere tomb, Sarteano (Agro chiusino). End of third century B.C. Siena, Museo Archeologico Nazionale B731. Pl. 64 in Sprenger and Bartoloni (1977). Pl. 403.2 in Giglioli (1935).

S-39 (1) Hellenistic marble relief of a hero. Pergamon. End of third century B.C/ beginning of second century B.C. Istanbul Archaeological Museum, inv. 362 T (Cat. Mendel 90).

S-40 (2) **1 Scale.** Cacu attacked by the Vipinas brothers. Etruscan urn relief. Sarteano (Agro chiusino). c. second century B.C. Sarteano, Museo Civico Archeologico. Pl. 404.3 in Giglioli (1935).

S-41 (1) **1 Scale/Horseback.** Combat of Greeks and Trojans. Etruscan alabaster urn relief. Città delle Pieve (Agro chiusino). c. second century B.C. Florence, Museo Archeologico. Pl. 397.2 in Giglioli (1935).

S-42 (2) **2 Scale.** Death of Eteocles and Polyneices. Etruscan urn relief. Chiusi. c. second century B.C. Pl. 81b in Banti (1973).

S-43 (2) **2 Scale.** Duel of Eteocles and Polyneices. Etruscan alabaster urn relief. Chiusi. c. second century B.C. Copenhagen, Ny Carlsberg Glyptothek. Pl. 397.1 in Giglioli (1935).

S-44 (3) Combat of Greeks and Amazons. Etruscan urn relief (The cinerary urn of Larthi Patui). Chiusi. c. second century B.C. Chiusi, Museo Civico. Pl. 405.3 in Giglioli (1935).

S-45 (2) Ulysses and his companions transformed into beasts by Circe. Etruscan urn relief. Chiusi. c. second century B.C. Copenhagen, Glyptothek Ny Carlsberg. Pl. 399.1 in Giglioli (1935).

S-46 (1) Stone relief of Type IV armor from an unidentified monument. c. second century B.C. Paestum Museum. Pl. 44 in Polito (1998).

S-47 (2+) Sculptural reliefs of arms and weapons on the podium walls of a monument, possibly a Hellenistic-style Numidian heroon showing Macedonian influence, on the Sacred Hill at Simitthus-Chemtou, Tunisia. Probably second century B.C. In Connolly (1988), 147. Pls. 21–22 in Polito (1998).

S-48 (2) **2 Scale.** Eteocles and Polyneices. Etruscan sarcophagus relief. Chiusi. c. 200–175 B.C. London, British Museum. Fig. 147 in Spivey (1997).

S-49 (4) Amazonomachy frieze from the Artemision at Magnesia. c. 200–150 B.C. Paris, Louvre. Pl. 73 in Ridgway (1990). (Pieces of frieze also in Berlin and Istanbul).

S-50 (3) Stone relief of trophies and shield from the Piazza della Consolazione. Second–first century B.C. Rome, Capitoline Museum. Fig. 35 in Kleiner (1992). Pl. 51 in Polito (1998).

S-51 (6+) Reliefs of weapons. Temple of Athena Polias at Pergamon. c. 175–150 B.C. Berlin, Pergamon Museum. Pls. 27–29 in Polito (1998).

S-52 (6+) **3 Horseback.** Reliefs on Monument to Aemilius Paullus at Delphi. 168 B.C. Delphi Archaeological Museum. In Hackett (1989), 154. Fig. 209 in R. Smith (1991).

S-53 (2) **2 Scale.** Cacu assaulted by Aule and Caile Vipinas. Relief on Etruscan alabaster urn from the Tomba dei Purni, Città della Pieve (Agro chiusino). c. 150 B.C. Florence, Museo Archeologico Nazionale. Pl. 398.1 in Giglioli (1935).

S-54 (3+) Temple of Hekate friezes. City of Lagina in Caria (in present-day Anatolia, Turkey). Late second century B.C.–early first century B.C. Istanbul Archaeological Museum, M 223 (and 2 other panels). M 223, "Alliance" frieze, fig. 207.2 in R. Smith (1991).

S-55 (1) **1 Horseback.** Capaneus and Tydeus with the head of Melanippus at the Gate of Thebes. Etruscan alabaster cinerary urn with high-relief scenes from the Seven Against Thebes cycle. Volterra. Beginning of the first century B.C. Volterra, Museo Etrusco Guarnacci. Pl. 268a in Sprenger and Bartoloni (1977).

S-56 (1) Stone relief of Type IV armor and shields from a funerary monument. c. first century B.C. Narbonne, Lapidary Museum, inv. 1619. Pl. 115 in Polito (1998).

S-57 (2) Sculptural relief of arms from an unidentified monument. c. first century B.C. Turin, Museo Archeologico. Pl. 108 in Polito (1998).

S-58 (1) Sculptural relief of arms. Gravestone of Ariston and Gykeia. First century B.C. Istanbul Archaeological Museum, inv. 3980 T.

S-59 (1) **1 Scale.** Sculptural relief of arms from a funerary monument, in the oratorio of S. Cesidio, Trasacco. Late first century B.C. Pl. 103 in Polito (1998).

S-60 (1) Frieze of armor and shields. Triumphal Arch of the Sergii (symbolic of victory at Actium). Pula, Croatia. c. 29–27 B.C. Pl. 81 in Polito (1998).

S-61 (1) Relief of Type IV armor from a funerary monument. Very late first century B.C. Modena, Museo Lapidario Estense. Pl. 91 in Polito (1998).

S-62 (2) The Gemma Augustea. Onyx cameo. Early first century A.D. Vienna, Kunsthistorisches Museum, inv. no. IXa 79.

Terracotta Sculptures and Reliefs

T-1 (4) **1 Horseback**. Fighting warriors. Etruscan terracotta gable relief. Arezzo, Piazza S. Jacopo. 600–575 B.C. Pl. 136 in Sprenger and Bartoloni (1977).

T-2 (2) **1 Horseback**. Two warriors. Archaic terracotta relief (terminal tile which formed part of sima of a pediment) of uncertain provenance. c. 600–500 B.C. Florence, Museo Archeologico, no. 4932. Pl. 160, no. 551 in Andrén (1939).

T-3 (1) Fighting warriors. Etruscan architectural terracotta from the Temple of Juno Moneta, Segni (Signia). 600–400 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Pl. 167.1 in Giglioli (1935). Pl. 120, no. 424 in Andrén (1939).

T-4 (1) Fighting warriors. Etruscan architectural terracotta from the Temple of Mater Matuta, Conca (Satricum). 600–400 B.C. Rome, Museo Nazionale di Villa Giulia. Pl. 167.2 in Giglioli (1935). Pl. 141, no. 492 in Andrén (1939).

T-5 (9) **2 Scale.** Warriors. Etruscan pedimental terracotta. Cerveteri (Caere). c. 600–400 B.C. (?). Copenhagen, Ny Carlsberg Glyptothek. Pl. 164.2 in Giglioli (1935). Pls. 126–28 in Sprenger and Bartoloni (1977). Pl. 11, no. 41 in Andrén (1939).

T-6 (2) Two warriors leading horses. Clazomenian sarcophagus detail. The Albertinum Group. Clazomenae. c. 530–470 B.C. Berlin 4824. Fig. 354 in Boardman (1998).

T-7 (1) Combat of two warriors. Terracotta arula with decoration in relief. Locri. c. 525–500 B.C. Reggio Calabria, Museo Nazionale. Fig. 413 in Carratelli et al. (1983).

T-8 (2) Two warriors fighting. Fragment of an Etruscan acroterion fittile from the Temple of Sassi Caduti. Civita Castellana (Falerii Veteres). c. 500–475 B.C. Rome, Museo Nazionale di Villa Giulia. Pl. 162 in Giglioli (1935). Pl. 36, no. 124 in Andrén (1939).

T-9 (1) **2 Scale.** Two hoplites. Terracotta relief plaque. Apollonia Pontica, Thrace (Sozopol, Bulgaria). c. 500–450 B.C. Paris, Musée du Louvre CA 1748.

T-10 (1) Ajax. Painted terracotta acroterion from the Sanctuary of the necropolis of

Cannicella at Orvieto. c. 490–480 B.C. Orvieto, Museo Archeologico, cat. 268. In Torelli (2000), 242.

T-11 (1) Scene from the Theban Cycle. Etruscan architectural terracotta from the area of Temple A at Pyrgi. c. 450 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Fig. 83 in Spivey (1997).

T-12 (1) Torso of Amazon. Archaic terracotta from the Esquiline, Rome. c. 450 B.C. (?). Rome, Antiquarium Comunale, nos. 3363, 3378. Pl. 107, no. 382 in Andrén (1939).

T-13 (1) Melian (terracotta) relief. Ransom of Hektor (grieving Priam at right). c. 440 B.C. Toronto, Royal Ontario Museum 926.32. Fig. 319 in Carpenter (1991).

T-14 (1) **1 Scale.** Warrior (lower half). Pedimental terracotta from the Temple at the Belvedere, Orvieto. Early fourth century B.C. Orvieto, Museo dell'Opera del Duomo. Pl. 65, no. 212 in Andrén (1939).

T-15 (1) **1 Scale.** Young warrior. Pedimental terracotta from the Temple at the Belvedere, Orvieto. Early fourth century B.C. Orvieto, Museo dell'Opera del Duomo. Pl. 64, no. 210 and Pl. 66, no. 216 in Andrén (1939).

T-16 (1) Terracotta figure of warrior. c. fourth century B.C. Bosporan kingdom (?). Odessa Archaeological Museum, Ukraine.

T-17 (1) Female figure (Victory or Lasa) carrying dead warrior. Etruscan architectural terracotta from the Larger Temple, Vignale. Civita Castellana. Third century B.C. Pl. 31, no. 108 in Andrén (1939).

T-18 (1) Warrior with shield. Architectural terracotta from the Temple in the Zona Archaeologica, Fiesole. Second–first century B.C. Fiesole, Museum Faesulanum, no. 405. Pl. 102, no. 368 in Andrén (1939).

T-19 (1) Combat scene. Etruscan terracotta cinerary urn with traces of polychromy. c. second century B.C. Perugia, Museo Archeologico.

T-20 (1) Combat scene: "Fight around the altar." Painted Etruscan terracotta cinerary urn. c. second century B.C. Palermo, Museo Archeologico Regionale.

T-21 (2) Combat scene. Etruscan terracotta cinerary urn with traces of polychrome. Chiusi. Mid-second century B.C. Worcester, MA, Worcester Art Museum 1926.19.

T-22 (1) Fighting warriors, probably a scene from the Seven against Thebes. Etruscan terracotta cinerary urn. Provenance unknown, but probably Chiusi. Mid-second century B.C. Ann Arbor, MI, Kelsey Museum 1461.

T-23 (1) Relief of the death of Eteocles and Polyneices. Etruscan architectural terracottas from the Temple of Talamone. c. 150 B.C. Florence, Museo Archeologico. Pl. 83, no. 289 in Andrén (1939).

T-24 (2) Scenes from the Seven against Thebes: at right, Amphiaraos the Seer swallowed by chasm opened by Zeus's thunderbolt; at left, Adrastos. Etruscan terracotta pedimental decoration from the Temple of Talamone. c. 150 B.C. Florence, Museo Archeologico. Pl. 82, no. 285 in Andrén (1939).

T-25 (1) Fragmentary figure in armor. Architectural terracotta remains found in the Via S. Gregorio, Rome. Late second or early first century B.C. Rome, Antiquarium Comunale. Pl. 112, no. 398 in Andrén (1939).

Metal Objects

M-1 (1) Warrior in Type IV. Etruscan bronze statuette. Umbria. Fifth century B.C. University of Oxford, Ashmolean Museum.

M-2 (1) Warrior. Etruscan bronze statuette. c. fifth century B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Pl. 222.8 in Giglioli (1935).

M-3 (1) Warrior. Etruscan bronze statuette. c. fifth century B.C. Paris, Bibliothèque Nationale. Pl. 222.3 in Giglioli (1935).

M-4 (1) Warrior. Etruscan bronze statuette. c. fifth century B.C. Paris, Bibliothèque Nationale. Pl. 222.4 in Giglioli (1935).

M-5 (2) Evzicle (Eteocles) and Fulnike (Polyneices) dueling. Etruscan incised bronze mirror. Fifth century B.C. Unknown provenance. British Museum GR 1847.9-9.2. Fig. 146 in Spivey (1997). Corpus Speculorum Etruscorum Great Britain 1: The British Museum I, no. 21.

M-6 (1) **1 Scale.** Hamfiare (Amphiaraos), Lasa, and Aivas (Ajax; because of his youth, may be Ajax Oileus). Etruscan incised bronze mirror. Vulci. Fifth century B.C. British Museum GR 1847.9-9.4. Corpus Speculorum Etruscorum Great Britain 1: The British Museum I, no. 28.

M-7 (2) **1 Scale.** Laran killing Cerselnu. Etruscan incised bronze mirror. Populonia. Fifth century B.C. Florence, Museo Archeologico. Pl. 150 in Moretti (1970).

M-8 (2) Two fighting warriors (Eteocles and Polyneices?). Etruscan bronze vase handle. c. 480–470 B.C. Paris, Musée du Louvre. Pl. 294.2 in Giglioli (1935).

M-9 (1) Two warriors. Etruscan bronze candelabrum finial. c. 480–470 B.C. New York, Metropolitan Museum of Art, accession #47.11.3.

M-10 (2) Dueling warriors. Cast bronze relief on cheekpiece of helmet. Todi. c. 470–460 B.C. Roma, Museo Nazionale Etrusco di Villa Giulia 219. Pl. 219.1 in Giglioli (1935).

M-11 (2) **1 Horseback/Scale, 1 Foot/Scale**. Fighting warriors. Handle of gold comb. Solocha, south Russia. c. 450 B.C. St. Petersburg, Hermitage Museum. Fig. 161 in Boardman (1985).

M-12 (2) **1 Scale.** Achle (Achilles) killing Memnun (Memnon), who is falling into the arms of his mother Eos. Etruscan incised bronze mirror. c. 450–420 B.C. New York, Metropolitan Museum of Art 22.139.84. Corpus Speculorum Etruscorum USA 3: New York, Metropolitan Museum of Art, no. 21.

M-13 (1) Warrior. Etruscan bronze votive statuette. Provenance unknown. c. 450–400 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Pl. 186 in Sprenger and Bartoloni (1977).

M-14 (1) Warrior. Etruscan bronze votive statuette. Provenance unknown. c. 450–400 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia. Pl. 186 in Sprenger and Bartoloni (1977).

M-15 (1) **1 Scale.** Warrior. Etruscan bronze statuette. c. 450–400 B.C. Florence, Museo Archeologico, cat. 196. Pl. 221.2 in Giglioli (1935).

M-16 (1) **1 Scale.** Warrior. Etruscan bronze statuette. c. 450–400 B.C. Naples, Museo Archeologico Nazionale. Pl. 221.3 in Giglioli (1935).

M-17 (2) [Z]imite (Diomedes?), Utuse (Odysseus), and Pentasila (Penthesilia). Etruscan incised bronze mirror. Found near Orvieto. c. 425–350 B.C. British Museum

GR 1913.12-17.1. Corpus Speculorum Etruscorum Great Britain 1: The British Museum I, no. 22.

M-18 (1) **1 Scale.** The Mars Todi. Bronze statue. Todi. Late fifth century B.C.–early fourth century B.C. Vatican City, Museo Gregoriano Etrusco Vaticano 693. Pl. 250 in Giglioli (1935). Pls. 200-01 in Sprenger and Bartoloni (1977). Pl. 121 in Goldscheider (1941).

M-19 (1) **1 Scale.** Warrior. Etruscan bronze statuette. Falterona. c. 400 B.C. London, British Museum. Pl. 221.1 in Giglioli (1935). Pl. 106 in Goldscheider (1941).

M-20 (1) Greek warrior fighting Amazon. Etruscan incised bronze mirror. c. fourth century B.C. London, British Museum GR 1824,0489.82. British Museum, Greek and Roman Antiquities catalogue no. Bronze 706.

M-21 (1) Menelaus and Helen. Etruscan incised bronze mirror. Fourth century B.C. London, British Museum.

M-22 (1) Etruscan incised bronze cist. c. fourth century B.C. Rome, Museo Nazionale Etrusco di Villa Giulia, cist inv. 13141. Fig. 1 in Gilotta (2002).

M-23 (3) **1 Scale.** Etruscan incised bronze cist (known as "the Napoleon Cist"). c. fourth century B.C. Fig. 12 in Bonamici (2002).

M-24 (1) **1 Scale.** Warrior and his wife. Etruscan bronze candelabrum finial. Marzabotto. c. 400–350 B.C. Marzabotto, Museo Aria. Pl. 252.1, 252.3 in Giglioli (1935).

M-25 (1) **1 Scale.** Warrior. Etruscan bronze statuette. Falterona. c. 400–350 B.C. London, British Museum. British Museum, Greek and Roman Antiquities Catalogue no. Bronze 459. Pl. 252.2 in Giglioli (1935). Pl. 105 in Goldscheider (1941).

M-26 (2) Hypnos and Thanatos carrying a dead warrior. Etruscan bronze cist handle. c. 400–375 B.C. Cleveland, OH, Cleveland Museum of Art.

M-27 (2) Aivas (Ajax) and Ectur (Hektor). Etruscan incised bronze mirror. Vulci. c. 400–350 B.C. British Museum GR 1847.9-9.5. Corpus Speculorum Etruscorum Great Britain 1: The British Museum I, no. 25.

M-28 (1) **1 Scale.** Warrior carried by Lasa. Etruscan incised bronze mirror. c. 400–350 B.C. Cleveland Museum of Art 16.2012. Corpus Speculorum Etruscorum USA 1: Midwestern Collections, Cleveland Museum of Art, no. 15.25210.

M-29 (3) Two warriors carrying fallen comrade. Etruscan bronze cist handle. c. 350 B.C. Rome, Museo Nazionale di Terme. Pl. 61 in Goldscheider (1941).

M-30 (1) Struggle over body of a wounded youth. Fragmentary Etruscan bronze cist handle. Provenance unknown. c. 325–300 B.C. Florence, Museo Archeologico. Pl. 236 in Sprenger and Bartoloni (1977).

M-31 (1) Two Amazons carrying fallen comrade. Etruscan bronze cist handle. Palestrina. c. 325–300 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 13199. Pl. 105 in Pallottino (1955).

M-32 (1) Figurine of barefooted general holding liver of sacrificial animal for divination purposes (probably Kineas, philosopher and counselor of Pyrrhos). Late fourth–early third century B.C. Athens, National Museum 16727.

M-33 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 742.

M-34 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 743.

M-35 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 744.

M-36 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 745.

M-37 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 746.

M-38 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Postolacca (1868), no. 747.

M-39 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Crosby (1964), no. L227.

M-40 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Crosby (1964), no. L228.

M-41 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. In Crosby (1964), no. L229.

M-42 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. Pl. 40, no. 2 in Kroll (1977b).

M-43 (1) Lead quartermasters' (?) token stamped with Type IV corselet. From deposit in the Agora, Athens. c. third century B.C. Pl. 40, no. 3 in Kroll (1977b).

M-44 (1) Ziumite (Diomedes), Atunis (Adonis), and Turan (Aphrodite). Etruscan incised bronze mirror. c. fifth–third century B.C. Schloss Fasanerie (bei Fulda), Kurhessische Hausstiftung Inv. ABr. 52. Corpus Speculorum Etruscorum Bundesrepublik Deutschland 1: Schloss Fasanerie (bei Fulda), no. 39.

M-45 (1) Two warriors in combat. Etruscan incised bronze mirror. c. fifth–third century B.C. Bonn, Akademisches Kunstmuseum C 29. Corpus Speculorum Etruscorum Bundesrepublik Deutschland 1, no. 5.

M-46 (1) Orestes killing Clytemnestra. Etruscan incised bronze mirror. c. fifth–third century B.C. Tübingen, Inv. 88, Stiftung E. v. Sieglin 1906/7. Corpus Speculorum Etruscorum Bundesrepublik Deutschland 3, no. 15.

M-47 (1) Achle (Achilles), Menle (Menelaos), and Ectur (Hektor). Etruscan incised bronze mirror. c. fifth–third century B.C. Berlin, Staatliche Museen, Antikensammlung M. I. 7275.1877. Corpus Speculorum Etruscorum Deutsche Demokratische Republik I, no. 30.

M-48 (1) Two warriors. Etruscan incised bronze mirror. c. fifth–third century B.C. Private collection, Brussels. Corpus Speculorum Etruscorum Belgique 1, no. 30.

M-49 (1) Menelaos menacing Helen. Etruscan incised bronze mirror. c. fifth–third century B.C. Paris, Musée du Louvre 1744, Coll. Campana (1862). Corpus Speculorum Etruscorum France 1: Paris, Louvre I, no. 11.

M-50 (2) 2 warriors fighting. Etruscan incised bronze mirror. c. fifth–third century B.C. Bologna, Museo Civico Archeologico, Inv. It. 1070, coll. Palagi No. 1821. Corpus

Speculorum Etruscorum Italia 1: Bologna, Museo Civico I, no. 40.

M-51 (1) 2 warriors. Etruscan incised bronze mirror. c. fifth–third century B.C. Bologna, Museo Civico Archeologico, Inv. It. 728, coll. Universitaria No. 284. Corpus Speculorum Etruscorum Italia 1: Bologna, Museo Civico I, no. 2.

M-52 (1) Eos and Memnon. Etruscan incised bronze mirror. c. fifth–third century B.C. Copenhagen, Danish National Museum 3403. Corpus Speculorum Etruscorum Denmark 1, no. 22.

M-53 (1) Warrior. Etruscan incised bronze mirror. c. fifth–third century B.C. In H. Walters (1899) *Catalogue of the Bronzes, Greek, Roman and Etruscan, in the British Museum*, London, No. 719. Tav. CCXLVI (a) in Bordenache Battaglia and Emiliozzi (1979).

M-54 (2) **2 Scale.** Warriors (two on foot, two on horseback) in combat. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Berlin, Charlottenburg, Staatliche Museen, Antiken-Abteilung, Inv. Misc. 6236. Cist I, Tav. II, I b in Bordenache Battaglia and Emiliozzi (1979).

M-55 (10) **5 scale**. Warriors in combat. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Copenhagen, Ny Carlsberg Glyptotek, Inv. H. 241, H. I. N. 43. Cist III, Tav. VII, III e, f in Bordenache Battaglia and Emiliozzi (1979).

M-56 (12) **8 scale**. Warriors carrying fallen comrade; warriors in combat. Handle and lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. London, British Museum, Inv. 738-20 263. Cist IV, Tav. VIII, IV a and Tav. IX, IV b in Bordenache Battaglia and Emiliozzi (1979).

M-57 (3) **2 scale**. Amazonomachy with Heracles. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Palestrina, Museo Archeologico, Inv. 1494. Cist VI, Tav. XV, VI e in Bordenache Battaglia and Emiliozzi (1979).

M-58 (14) **11 scale**. Warriors carrying fallen comrade; warriors in combat. Handle and lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Rome, Museo Nazionale di Villa Giulia, Inv. 25210 Cist. VII, Tavs. XVII, VII b and c; XVIII, VII d; and XIX, VII e, in Bordenache Battaglia and Emiliozzi (1979).

M-59 (3) **1 scale**. Scene with fighting warriors and winged goddesses. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Rome, Museo Nazionale di Villa Giulia, Inv. 15693. Cist VIII, Tav. XXI, VIII c in Bordenache Battaglia and Emiliozzi (1979).

M-60 (6) **6 scale**. Warriors in combat. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Rome, Museo Nazionale di Villa Giulia, Inv. 51208–51209. Cist IX, Tavs. XXIV, IX a and XXV, IX b in Bordenache Battaglia and Emiliozzi (1979).

M-61 (10) **10 scale**. Warriors in combat. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Rome, Museo di Villa Giulia, Inv. 13086. Cist X, Tavs. XXVIII, X c and XXIX, X d in Bordenache Battaglia and Emiliozzi (1979).

M-62 (1) Two youths fighting a lion and a griffin. Lid of Etruscan incised bronze cist. Palestrina. c. third century B.C. Baltimore, Walters Art Museum, Inv. 54.136. Cist 1, Tav. XLVII, 1 h in Bordenache Battaglia and Emiliozzi (1979).

M-63 (3) Two soldiers carrying a fallen comrade. Handle of Etruscan incised bronze cist. Palestrina. c. third century B.C. Berlin, Charlottenburg, Staatliche Museen, Antike Abteilung, Inv. 6239. Cist 5, Tav. LXI, 5 c and

5 d in Bordenache Battaglia and Emiliozzi (1979).

M-64 (1) **1 Carried.** Naked warrior carrying Type IV corselet. Etruscan incised bronze cist. Palestrina. c. third century B.C. Boston, Museum of Fine Arts 93.1439a, b. Cist 10*, Tav. LXXVI, 10 e in Bordenache Battaglia and Emiliozzi (1979). Note that the ancient provenance of this cist is disputed.

M-65 (1) Quadriga and gigantomachy. Etruscan incised bronze cist. Palestrina. c. third century B.C. Cambridge, UK, Fitzwilliam Museum Gr. 3/1165. Cist 13*, Tavs. LXXXIII, 13 b and LXXXV, 13 e in Bordenache Battaglia and Emiliozzi (1979). Note that the ancient provenance of this cist is disputed.

M-66 (4) **3 scale**. Combat between warriors in the presence of a winged Athena. Etruscan incised bronze cist. Palestrina. c. third century B.C. Copenhagen, Nationalmuseet, Antiksamlingen 778. Cist 16, Tavs. XCIV, 16 a; XCV, 16 b; XCVI, 16 d; and XCVII, 16 f, in Bordenache Battaglia and Emiliozzi (1979).

M-67 (2) **2 scale**. Centauromachy. Etruscan incised bronze cist. Palestrina. c. third century B.C. Lyon, Musée des Beaux Arts E-154. Cist 26, Tavs. CXXVIII, 26 b and CXXX, 26 c in Bordenache Battaglia and Emiliozzi (1979).

M-68 (1) Sacrifice of Trojan prisoners. Etruscan incised bronze cist (known as "the Revil cist"). Palestrina. c. third century B.C. London, British Museum 59.8-16.1. Cist 29, Tavs. CXXXVIII, 29 g and CXXXIX, 29 l in Bordenache Battaglia and Emiliozzi (1979).

M-69 (1) Bellerophon and Pegasus. Etruscan incised bronze cist. Palestrina. c. third century B.C. London, British Museum 84.6-14.33. Cist 32, Tav. CXLVI, 32 d in Bordenache Battaglia and Emiliozzi (1979).

M-70 (2) Fight between Greeks and Amazons. Etruscan incised bronze cist. Palestrina. c. third century B.C. London, British Museum 88.5-1.1. Cist 33*, Tavs. CXLIX, 33 c and CL, 33 f in Bordenache Battaglia and Emiliozzi (1979). Note that the ancient provenance of this cist is disputed.

M-71 (3) Lid of Etruscan incised bronze oval cist (known as "the Pasinati cist"). Palestrina. c. third century B.C. London, British Museum 84.6-14.34. Cist 36*, Tavs. CLVI, 36 a and CLVIII, 36 d in Bordenache Battaglia and Emiliozzi (1979). Note that the ancient provenance of this cist is disputed.

M-72 (1) **1 scale**. Departure or return of warriors. Etruscan incised bronze cist (known as "the Borgia cist"). Palestrina. c. third century B.C. Naples, Museo Archeologico Nazionale 5666. Cist 41, Tav. CLXX, 41 b in Bordenache Battaglia and Emiliozzi (1979).

M-73 (2) **2 scale**. Scene related to an episode from the Trojan legend. Etruscan incised bronze cist. Palestrina. c. third century B.C. New York, Metropolitan Museum 22.84.1. Cist 42, Tav. CLXXVIII, 42 h in Bordenache Battaglia and Emiliozzi (1979).

M-74 (1) Images with incised names derived from the Trojan legend. Etruscan incised bronze cist. Palestrina. c. third century B.C. New York, Pierpont Morgan Library BL-64. Cist 45, Tavs. CLXXXVII, 45 d and CXCIV, 45 q in Bordenache Battaglia and Emiliozzi (1979).

M-75 (1) Scene with victorious boxer. Etruscan incised bronze cist. Palestrina. c. third century B.C. Palestrina, Museo Archeologico 1493. Cist 49, Tav. CCXV, 49 h in Bordenache Battaglia and Emiliozzi (1979).

M-76 (3) Battle scene. Etruscan incised oval bronze cist. Palestrina. c. third century B.C.

Palestrina, Museo Archeologico 1495. Cist 54, Tavs. CCXXXVII, 54 f and CCXL, 54 l in Bordenache Battaglia and Emiliozzi (1979).

M-77 (1) Five youths and warrior with horse. Etruscan incised rectangular bronze container. Palestrina. c. 300–250 B.C. Rome, Museo Nazionale Etrusco di Villa Giulia 13133. Pl. 106 in Pallottino (1955).

M-78 (1) Warrior in Type IV confronts youth. Etruscan bronze relief from a lidded mirror. Tuscany. c. 250–150 B.C. London, British Museum GR 1847,1101.12. Greek and Roman Antiquities catalogue no. Bronze 730.

M-79 (1) **1 Horseback**. Alexander the Great on horseback. Bronze statue. First century B.C–first century A.D. Naples, Museo Archeologico Nazionale 4996. In Stefano De Caro, *The National Archaeological Museum of Naples*, Electa Napoli, 218.

M-80 (1) Philip of Macedon. Gold medallion. Tarsus. c. 240 A.D. Paris, Bibliothèque Nationale. In Sekunda (1984), 3.

Paintings

P-1 (1) Persian horseman spearing Greek hoplite. Karaburun II tomb chamber. Lycia. Early fifth century B.C. Figs. 10 and 11 in Krentz (2010). See also Mellink (1972).

P-2 (1) Tomb of Orcus. Hades, Persephone, and Geryon (in Type IV). Etruscan tomb painting. Tarquinia. c. 400–300 B.C. Pl. 248 in Giglioli (1935).

P-3 (4) Amazonomachy. The Amazon Sarcophagus. Etruscan painted marble sarcophagus. Tarquinia. c. 350 B.C. Florence, Museo Archeologico. Pl. 238 in Giglioli (1935). Pls. 212, 214 in Sprenger and Bartoloni (1977).

P-4 (11) Amazonomachy and sacrifice of the Trojan prisoners. Etruscan painted marble sarcophagus (known as "the Sarcophagus of the Priest"). c. 350 B.C. Tarquinia, Museo Archeologico Nazionale Tarquiniense. Pls. 1–12 in Blanck (1982).

P-5 (3) Achilles sacrificing Trojan prisoners to the shade of Patroklos. Etruscan tomb painting from the François Tomb. Vulci. c. 350–300 B.C. Rome, Museo Torlonia. Pl. 266 in Giglioli (1935).

P-6 (2) Group of warriors. Tomb III at Agios Athanasios. c. 350–300 B.C. Pl. 23B in Tsibidou-Avloniti (2002).

P-7 (1) Warrior. Wall-painting in Macedonian tomb, the "Bella Tumulus." Vergina. Late fourth century B.C.

P-8 (1) Warrior. Facade of Macedonian tomb, the "Great Tomb" (Tomb 18C). Lefkadia. c. third century B.C. Pl. 8b in S. Miller (1993).

P-9 (2) Corselets on armor stands. Macedonian tomb paintings in tomb of Lyson and Kallikles. Lefkadia. c. second century B.C. Pl. 4 in Polito (1998). Pls. II, III, 9, and 13a in S. Miller (1993).

P-10 (1) **1 Horseback/Scale.** Alexander the Great fighting Darius III (probably at the Battle of Issus). The Alexander Mosaic. From the House of the Faun, Pompeii. c. 100 B.C. Copy of either a Greek painting by Apelles from c. 300 B.C. or a fresco by Philoxenos of Eretria from the late fourth century B.C. Naples, Museo Archeologico Nazionale.

Totals

Black-figure vases: 96 images, 48 items
White-ground technique vases: 12 images, 12 items
Red-figure vases: 464 images, 249 items
Stone sculptures / reliefs: 115 images, 62 items
Terracotta sculptures / reliefs: 41 images, 25 items
Metal objects: 158 images, 80 items
Paintings: 27 images, 10 items
913 images total, 486 items

Specialized

Putting on armor: 18 images
Horseback: 42 images
Carried: 5 images
Scale: 201 images
Etruscan: 235 images
Etruscan scale: 79 images

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Introduction

1. See, for example, Heckel and Jones (2006), de Souza, Heckel, and Llewellyn-Jones (2004), and Sekunda (1984, 2000). Such books as those in the Osprey series occupy an unusual middle ground between scholarly and popular publications. They are often written by academics or highly knowledgeable individuals and sometimes present original research, yet typically they are aimed at a general readership and lack a full-fledged scholarly apparatus such as footnotes.

2. Some of the more serious and informative reenactor sites in the English-speaking world include http://www.4hoplites.com/Linothorax.htm, http://sydneyancients.5u.com/, www.thegreekwarriors.com, and http://www.larp.com/hoplite/linothor.html.

The Korybantes group is a relatively recent but quite active reenactment association based in Greece, whose Web site (currently mostly in Greek) has excellent photos: http://www.koryvantes.org/koryvantes/index. The armorer of this group, Dimitrios Katsikis, has his own lavishly illustrated Web site (in Greek) featuring and selling his work as well as providing handy pdf copies of several articles he has published in Greek magazines: http://www.hellenicarmors.gr/.

One of the longest-running (and by now, very lengthy) online discussion threads about the nature and construction of the linothorax written by a mix of reenactors, historical enthusiasts, and scholars can be found in the Greek section of the Roman Army Talk Web site. See, for example, http://www.romanarmytalk.com/rat/viewtopic.php?f=19&t=25938. While it is not in the form of traditional scholarship and necessitates wading through much material that is tangential, this discussion thread nevertheless does include useful observations based both on ancient literary and archaeological evidence and on practical experimentation.

Recently, some companies have begun offering "linothorakes" for sale on the Internet. These vary widely in quality; many are laughably inaccurate, but a few are reasonably plausible variants.

3. Sabin, van Wees, and Whitby (2007, 115, 150, 195, 391). The cited comment about making do with linen armor can be found in the contribution to this volume by Krentz (2007, 150).

4. Margarita Gleba (2012) was kind enough to share with the authors a draft of this article, which, at the time of writing this book, was still in press. On Etruscan linen armor, see also Gleba (2008, 68). Other brief discussions of linen armor in important recent works on Greek warfare include Krentz (2010, 46-47) and Lee (2007, 111). In addition to the books and articles cited above, several articles have focused fairly narrowly, and from a more literary than historical or military perspective, on the cryptic references to linen armor in Herodotus. These include Moxon (2000), Francis and Vickers (1984), and Picard (1957). This passage from Herodotus is discussed in detail in chapter 1.

5. Another important early German work on Greek armor, and one that has greatly influenced subsequent discussions of the weight of the hoplite panoply, is Rüstow and Köchly (1852).

6. Much of the debate surrounding this type of armor centers on whether it was made of linen or leather (see chapter 3). Given the highly perishable nature of these materials, no credible extant examples made of either substance have been found. However, excavators have uncovered metal rings, scales, and other fittings and decorations that they have identified as having originally been part of a linothorax or a piece of Type IV armor. See, for example, the much-debated fittings found by Andronikos (1984, 217) in Tomb III at Vergina and also discussed by Hammond (1989, 1991).

7. For example, some reenactor groups use the descriptive phrase "tube and yoke" armor to refer to Type IV armor, but this term is rarely employed in academic publications. For a typology of later Roman cuirasses that have a different construction from Type IV armor but similar-looking shoulder flaps, see Stemmer (1978).

8. A summary of attempts at experimental archaeology from the nineteenth to the mid-twentieth century is offered by Forrest (2008). Coles (1973) describes a broad range of reconstruction experiments undertaken in the 1960s and 1970s. See also Mathieu (2002). More recently, archaeologists of cultures in the Americas have been particularly enthusiastic practitioners of this approach. Excellent collections of papers describing some of this research can be found in Cunningham, Heeb, and Paardekooper (2008) and Ferguson (2010).

9. Griffiths (2000, 135). This comment is drawn from the opening paragraph of the article "Re-enactment as Research: Towards a Set of Guidelines for Re-enactors and Academics," which defends the applicability of this approach to scholarship on the ancient world. It is in a special issue of the *Journal of Roman Military Equipment Studies* devoted to the topic of "Re-enactment as Research." Another useful discussion of some of the advantages as well as the pitfalls of this approach can be found in the *Journal of Roman Archaeology* survey article by Junkelmann (2010) assessing the recent spate of books that recount separate elaborate attempts in Germany, France, and Italy to reconstruct gladiatorial combat techniques and equipment. For other examples of recent, well-done projects in experimental archaeology covering a broader range than just the ancient Mediterranean world, see the collections of reports gathered in Ferguson (2010) and Cunningham, Heeb, and Paardekooper (2008).

10. Quoted in Ferguson (2010, 2). This essay also offers a generally useful theoretical discussion of the advantages and dangers of experimental archaeology.

11. See, for example, the experiments described in Mathieu (2002), Cunningham, Heeb, and Paardekooper (2008), and Ferguson (2010).

12. On Roman military equipment, a handy survey is Griffiths (2000). For a case study involving Roman javelins, see Griffiths and Sim (1993). On gladiators, see Junkelman (2008, 2010), Battaglia (2002), Battaglia and Ventura (2010), Teyssier and Lopez (2005), and Teyssier (2009). Peter Connolly has for many years successfully combined primary sources and reconstructive techniques to investigate a range of equipment, from saddles to armor. See, for example, Connolly (1987, 1991, 2000). Some useful and serious reconstructive work on the linothorax is being done by reenactor groups, most of whose members are not professional academics. For some examples of these, see note 2 above. For a discussion of some of the problems and issues that accompany attempts to do reconstructive experiments involving ancient textiles, a topic of particular relevance to the subject of this book, see the well-balanced discussion of this topic by Jolie and McBrinn (2010).

13. TV documentaries: Canadian History Channel, *Museum Secrets: Athens Archaeological Museum* (first aired January 2012); Discovery Channel, *Penn and Teller Tell a Lie*, episode 6 (first aired November 9, 2011); German Television, *Galileo* (first aired June 9, 2010). The footage (without narration) of the *Galileo* program can be viewed on the Linothorax Project Web site at http://www.uwgb.edu/aldreteg/Linothorax.html; the Penn and Teller and the *Museum Secrets* episodes can be purchased on ITunes.

Magazine articles: *U.S. News and World Report*, special issue on "History's Mysteries" (August 2010); *Der Spiegel* (February 1, 2010); *Military History* (May 2010); *Polityka* (March 2010); *Y: The Magazine of the German Armed Forces* (Summer 2010); *Focus Italia* (May 2010). A longer online version of the *Der Spiegel* article can be seen at http://www.spiegel.de/wissenschaft/technik/0,1518,675814,00.html.

Online news stories: Discovery Channel News (January 2010) and MSNBC (January 2010). Versions of these two stories were widely translated into other languages and published by online news services in Italy, Greece, India, Japan, Russia, Germany, Poland, Lithuania, Serbia, Macedonia, Hungary, and Romania. The Discovery Channel article can be viewed at http://news.discovery.com/history/linothorax-alexander-great-armor.html and the MSNBC version at http://www.msnbc.msn.com/id/34810209/ns/technology_and_science-science/t/laminated-linen-protected-alexander-great/.

14. For example, the documentaries all tended to focus heavily on the sensationalistic image of G. Aldrete shooting a linothorax-clad S. Bartell with an arrow, even though this experiment had little scientific value compared to our less photogenic (and infinitely more numerous) shots against test patches. Also, articles repeatedly portrayed it as a "new discovery" that linen armor was used in the ancient world, although we never made such a claim.

15. The first steps toward such a conversation have been taken in the somewhat analogous area of academics being hired as consultants to movies and television shows set in the ancient world. A high-profile example of this is Kathleen Coleman's account of her (mis)adventures while serving as historical consultant to the film *Gladiator*. Her comments on the problems interacting with the entertainment industry can be read in the article "The Pedant Goes to Hollywood: The Role of the Academic Consultant" (Coleman 2004). See also Kristina Milnor's description of being a historical consultant to HBO's *Rome* (Milnor 2008).

Chapter 1 • Ancient Evidence for Linen Armor

1. For examples, as well as other meanings of *thorax*, see the *Thesaurus Linguae Graecae* (http://www.tlg.uci.edu/) and the *Greek-English Lexicon* by Liddell and Scott.

2. These commentators or scholiasts of Homer include:

Aristonicus: *De Signis Iliadis*, book 2, verse h529–30, line of scholion 1; book 2, verses 529–30, line of scholion 3; book 2, verse 830, line of scholion 1; and book 13, verse 372, line in scholion 3.

Eustathius Thessalonicensis: *Commentarii ad Homerii Illiadem*, vol. 1, p. 785, line 28; vol. 1, p. 422, line 25; vol. 1, p. 424, line 25; vol. 1, p. 556, line 11; and *Sermones*, oration 5, line 131.

Scholia in Homerum, Scholia in Illiadem (scholia vetera): book 2, verse 229, line of scholion 2; book 2, verse 830, line of scholion 1; book 2, verses 529–30, line of scholion 4; book 2, verse 830a, line of scholion 1; book 2, verse 830b, line of scholion 1; book 13, verse 372, line of scholion 2; book 2, verse 528, line of scholion 3.

Scholia in Homerum, Scholia in Illiadem (scholia recentiora Theodori Meliteniotis, e cod. Genevensi gr. 44), book 2, verse 529, line of scholion 1.

3. This passage of Strabo is quoted verbatim by Posidonius, frag. 22, line 4.

4. On this oracle and its variants, see Fontenrose (1978, 276–78) and Parke (1956, vol. 2).

5. Some of the ancient authors and scholiasts who repeat this oracle include:

— Dinias (third century B.C.), *Fragmenta* 7, line 10.

— Pausanius (second century A.D.), letter upsilon, entry 5, line 8.

— Photius (ninth century A.D.), *Lexicon*, letter upsilon, p. 618, line 2.

— *Suda, Lexicon* (tenth century A.D.), letter upsilon, entry 108, line 5.

— Joannes Tzetzes (twelfth century A.D.), *Chiliades*, Chilias 9, history 272, line 487, and Chilias 9, history 291, line 881.

— *Certamen Homeri et Hesiodi*, line 301.

— *Scholia in Theocritum*, poem 14, verse 48/49a, line 13.

— *Anthologiae Graecae Appendix, Oracula*, epigram 61, line 6.

6. These lexicons, word lists, and grammatical works are:

— Hesychius, *Lexicon*, letter A, entry 1061, line 1.

— Suda, *Lexicon*, letter upsilon, entry 108, line 5.

— Aelius Herodianus, *De Prosodia Catholica*, part 3, vol. 1, p. 42, line 29; part 3, vol. 2, p. 740, line 5, and part 3, vol. 2, p. 740, line 5; part 3, vol. 2, p. 631, line 2 (ἀπὸ ἁπλοῦ ἐκτείνοντος τὸ α φυλάττει αὐτὸ ἐκτεταμένον οἷον Φαίαξ, φιλοφαίαξ, θώραξ λινοθώραξ).

— Georgius Choeroboscus, *Prolegomena et scholia in Theodosii Alexandrini canones isagogicos de flexion nominum*, p. 287, line 11; and p. 287, line 32.

7. Some significant works on Greek military equipment found at the sanctuary of Olympia are Kunze (1950, 1991), Bol (1989), Baitinger (2001), and Philipp and Born (2004). In English, see Jarva (1995).

8. The poem containing this citation is quoted by Athenaeus (14.23). Alcaeus frag. Z34 (Lobel-Page), 54 (Diehl).

9. *The Oxyrhynchus Papyri*, vol. 71, no. 4807, ed. R. Hatzilambrou et al. (2007), 15–26, Greek text on p. 21.

10. On Iphicrates's reforms, see also Diodorus 15.44.2-4. For discussion of the alleged reforms of Iphicrates, see Griffith (1981), Best (1969), and Everson (2004).

11. Alexander's wearing of Darius's corselet at Gaugamela could be viewed as a not-very-subtle reminder that he had already defeated the Persian king once before (e.g., Borza 1987, 112). On the items captured at Issus, see also Arrian 2.11.10, Curtius 3.13.2-17, and Diodorus 17.35.1-6.

Other scholars, however, have doubts about this passage (e.g., Hammond 1989, 223, n. 26). Plutarch himself does not refer to the corselet when describing the royal items seized at Issus, although he does specifically state that Alexander obtained Darius's chariot and bow on this occasion (*Alexander* 20.10). Nor does the corselet appear in the list of Darius's captured personal items found in Arrian, which includes a bow and shield (2.11.8).

12. In this passage, the standard corselet is mentioned only because Abradatas's wife then surprises him with a golden panoply (corselet, greaves, helmet, etc.). When discussing the customs of the Persians, Herodotus (1.135) comments that the type of body armor that they wear is not indigenous but rather was borrowed from the Egyptians. Although Herodotus does not specify the composition of this body armor, this passage has often been interpreted as referring to a linen corselet (e.g., Francis and Vickers 1984, 125).

13. The body armor worn by Alexander's troops is a matter of long-standing debate complicated by the many different types of foot and mounted soldiers in his army. For an assessment that nicely summarizes most of the previous arguments, see Lush (2007), who concludes that the available literary and iconographic evidence suggests that both members of the phalanx and mounted elements of the army did commonly wear body armor and that it was most likely nonmetallic. Earlier (and often conflicting) treatments of this subject include Everson (2004), Snodgrass (1999), Lloyd (1996), Borza (1990), Bosworth (1988), Head (1982), Markle (1977, 1978, 1982), Connolly (1988), Milns (1976), Lumpkin (1975), Adcock (1957), Griffith (1956–57), and Launey (1949). See also Feyel (1935).

14. On the Alexander Mosaic, see Moreno (2001), Cohen (2000), and Pfrommer (1998). On the Alexander Sarcophagus, see Pasinli (1997). On the painting of a Macedonian soldier on the facade of the Great Tomb at Lefkadia, see Petsas (1966). On the tomb under the Bella Tumulus at Vergina, see Andronikos (1981, 1982, 1984, 1987). On Tomb III at Agios Athanasios, see Tsibidou-Avloniti (2002). On these tombs generally, see Fedak (1990), Brecoulaki (2006), and S. Miller (1993).

15. There is ample evidence that the Macedonians, like the Greeks, were adept weavers (e.g., Diodorus 10.93.4; Curtius 5.2.18).

16. After the death of Philip's father, Amyntas, his mother Eurydice is said to have temporarily sought refuge for herself and her sons with Iphicrates (Cornelius Nepos, *Iphicrates* 11.3).

17. Livy adds the detail that this breastplate was described to him by none other than the emperor Augustus himself, who had seen the ancient armor and read its inscription in the course of restoring the temple.

18. For the arguments about the Samnites as producers of linen, see Shelton (2009).

19. While Italicus is sometimes denigrated as a source because of perceived deficiencies in the quality of his poetry, it should be noted that the poet was a former consul and proconsul and thus presumably was not entirely ignorant of military affairs.

20. Even if one discounts from this list all of the medieval commentators, the anonymous scholiasts, and passages from one author that are simply quoted by another, there are still at least 30 different extant descriptions of linen body armor by more than 20 famous ancient authors. Also, this list focused only on explicit references to body armor made of linen. There are many more references to other items of armor being made out of fabric, including helmets and greaves. For example, just in Herodotus's list of the elements of the Persian army, three groups are described as wearing "woven helmets": the Paphlagonians (7.72), the Mares (7.79), and the Egyptians (7.89).

21. See, for example, the articles by Moxon (2000), Francis and Vickers (1984), Törnkvist (1969), and Picard (1957).

22. On these issues, see especially Moxon (2000), Picard (1957), and Higbie (2003, 113–15).

23. Pliny, *Natural History* 19.2: "This may surprise people who do not know that in a breastplate that belonged to a former king of Egypt named Amasis, preserved in the temple of Minerva at Lindos on the island of Rhodes, each thread consisted of 365 separate threads, a fact that Mucianus, who held the consulship three times quite lately, stated that he had proved to be true by investigation, adding that only small remnants of the breastplate now survive owing to the damage done by persons examining this quality" (*mirentur hoc ignorantes in Agypti quondam regis quem Amasim vocant thorace in Rhodiorum insula Lindi in templo Minervae CCCLXV filis singula fila constare, quod se expertum nuperrime prodidit Mucianus ter cos., parvasque iam reliquias eius superesse hoc experientium iniuria*).

24. For practical aspects of growing and processing the flax plant, its range of growth, and linen in the ancient world generally, see Heinrich (2010), Carroll (1988), Baines (1989), Barber (1991, 1994), and the relevant chapters in Jenkins (2003), Gillis and Nosch (2007), and Gleba (2008).

25. On some other areas of major linen production, see Herodotus 2.105 and Strabo, *Geography* 11.2.17.

26. For details on the processing of flax, spinning, and weaving, see the relevant sections in Heinrich (2010), Baines (1989), Barber (1991, 1994), Gleba (2008), Gillis and Nosch (2007), and Jenkins (2003).

27. On ancient Greek vertical weighted looms, see Barber (1991), Hoffmann (1974), and McLauchlin (1981).

28. Pliny also notes, "Among the poppies there is also a variety that imparts a remarkable degree of whiteness to fabrics made of linen" (*Natural History* 19.4).

29. See, for example, the arming scenes on the following vases: R-26, Munich, Antikensammlungen 2307, ARV 26, 1, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 166.1, 172.1, CVA online vase #200160; R-28, Paris, Cabinet des Médailles 863, ARV 187, 53, CVA online vase #201705; R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-32, Munich, Antikensammlungen 2308, CVA Deutschland 12 München 4, pls. 169.1, 170.1, CVA online vase #200161; R-59, Madrid, Museo Arqueológico Nacional 11042, ARV 532, 49, CVA Espagne 2 Madrid, Museo Archeológico Nacional 2 (III.I.c), pl. 16.1a, CVA online vase #206026; R-61, Bologna, Museo Civico Archeologico, Pell. 274, CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 53.1, 55.7, CVA online vase #206069; R-63, Berlin 3233 (now lost), ARV

414, 32, CVA DDR 3 Berlin, Staatliche Museen zu Berlin, Antikensammlung-Pergamonmuseum 1, Missing Vases image 21, CVA online vase #204514; R-71, Brussels, Musée Royaux d'Art et d'Histoire R308, ARV 362, 16, CVA Belgique 2, pl. 15.3a, c, CVA online vase #203807; R-157, New York Market, Christie's XXXX205374, ARV 451, 3, CVA online vase #205374; R-164, Frankfurt, Städel Institute STV9, ARV 818, 16, CVA Deutschland 30 Frankfurt am Main 2, pl. 63.4, CVA online vase #210116; R-183, Bologna, Museo Civico Archeologico PU274, ARV 793, 78, CVA Italia 5 Bologna, Museo Civico 1 (III.I.c), pls. 16.1, 17.1, CVA online vase #209786; R-184, Palermo, Museo Archeologico Regionale 2564, ARV 1021, 115, CVA online vase #214296.

30. For some exceptions to this rule, see, for example, Schwartz (2009), Jarva (1995), and van Wees (2000). Schwartz (2009, 20–21) and Jarva (1995, 14–15) in particular include insightful discussions of potential problems in attempting to extrapolate details of military equipment from works of art. On this issue, as well as on the "realism" of Greek depictions of warfare in art, see also Hannestad (2001).

31. See Jarva (1995, 15).

32. Although the most common form of Type IV armor is one in which the two main components are made separately and then attached together, evidence from vase paintings suggests that in some cases, the armor was alternatively made by cutting out the entire shape from a single large sheet of material, such as an animal hide. The final appearance of armor made using either method is nearly identical. For more in-depth analysis of this issue, see chapter 2.

33. Anderson (1970, 267–68, n. 38) states that he looked through the volumes of CVA up to August 1964 and identified 186 instances of linen or leather corselets on 140 red-figure vases, but unfortunately he does not give any specific citations. He mentions a few other examples in n. 37 (267) and n. 54 (269).

Jarva (1995, 44–46) offers a useful catalog of some images of Type IV armor but restricts it primarily to images on black-figure vases and stone and terracotta sculptures. Jarva's list of black-figure images contains many that do not appear in our catalog because we listed only images that were complete and indisputably classifiable as Type IV. In correspondence with the authors (email, July 22, 2009), Jarva noted that he included a number in which the image is partial or the identification as Type IV is inferred from the presence of *pteruges* painted in white. Because many if not most of such instances probably do represent additional visual examples of Type IV armor, the total number of images of Type IV armor may be significantly higher. The forthcoming article by Gleba (2012) contains additional important examples of this type of armor in Etruscan art.

34. One group of images that we were tempted to place in their own category were the more than 200 Etruscan ones, because these formed an obvious subset and represented armor with a course of development distinct from that found in the eastern Mediterranean. Etruscan visual examples span nearly all the categories, including painted pottery, tomb paintings, and stone, metal, and terracotta sculpture. If we separated out the Etruscan material, however, it would be hard to justify not similarly segregating other ethnic or geographic categories, such as Macedonian, or mainland Greek versus Italic Greek. As there would be no limit to the possibilities for ever-finer divisions, this process would have resulted in a hopelessly fragmented catalog. In the end, therefore, we elected to keep the

database in the most straightforward possible form and leave the Etruscan examples interspersed with the others.

35. S-7, Persian cylinder seal depicting Persian king spearing a fallen hoplite (c. 500-475 BC), New York, Metropolitan Museum of Art. There are other images of Greek warriors in Persian art, but in the majority the Greek's national identity is indicated by a large round shield, Corinthian-type helmet, and heroic nudity. While it is interesting that the Persians associated nudity with Greekness, this visual convention is unfortunate from the perspective of those interested in ancient Greek armor, making this seal all the more significant for its rare depiction of Greek armor. For a discussion and more examples of Greek warriors in Persian art, see Ma (2008) and Boardman (2000).

36. On depictions of Amazons in Greek art, some wearing Type IV armor, see von Bothmer (1957). This book collects many images of Amazons on Greek vases, including some that show them wearing Type IV armor. Because there are several prominent and oft-cited vases that portray foreigners, in particular Amazons, wearing what appears to be Type IV armor, it has been suggested that it was a form of armor used mainly by non-Greeks. However, of the entire body of visual images (except for the Etruscan visual representations of Type IV armor, which show it on Etruscans or Etruscan gods and heroes), well over 90% of the remainder depict it being worn by Greeks rather than foreigners.

37. Homer, *Iliad* 2.529. Examples of images of the lesser Ajax wearing Type IV armor: R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, pl. 135 in Boardman (1975), CVA online vase #201724; R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829; R-240, Rome, Museo Nazionale Etrusco di Villa Giulia, pl. 103 in Woodford (1993); M-74, Etruscan bronze cist from Palestrina, Pierpont Morgan Library BL-64, Cist 45, Tavs. CLXXXVII, 45 d and CXCIV, 45 q in Bordenache Battaglia and Emiliozzi (1979).

38. The Alexander Mosaic (plate 2) from the House of the Faun at Pompeii is unquestionably the single most famous visual image of this form of armor, and is thought to be a Roman copy of a Hellenistic original. On the mosaic and this image, see Pfrommer (1998) and Moreno (2001).

39. Of the more than 200 Etruscan images, scales are found on about one-third. Of the non-Etruscan (overwhelmingly Greek) images, scales occur on just over one-fifth.

40. For recent accounts of the chronological development of Greek armor, see Schwartz (2009), Everson (2004), Snodgrass (1999), and Jarva (1995).

41. So, for example, Everson (2004, 110, 145–46) suggests that "another type of body armour which mainland and island Greeks, as well as others, did adopt from the Near East was armour made of linen," and that the Amasis donation further inspired the specific Type IV design. Others adopt a somewhat more cautious attitude; for example, Schwartz (2009, 70) notes that "the connection cannot be established with certainty, but scale corselets and armour made from linen had been known in the Orient for a very long time." See also Jarva (1995, 42–43).

42. For example, Anderson (1970, 21–22).

Chapter 2 • Structural Variants and Decorations on Type IV Armor

1. Examples of plain armor: R-5, Palermo, Museo Archeologico Regionale V667, ARV 211, 194, CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 20.1, CVA online vase #202013; R-6, Vienna, Kunsthistorisches Museum 654, ARV 201, 67, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 54.2, CVA online vase #201875; R-49, Basel, Antikenmuseum und Sammlung Ludwig BS453, ARV 1634, 30 bis, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2, CVA online vase #275091; R-115, Munich, Antikensammlungen 2425, ARV 294, 65, CVA Deutschland 20 München, Museum Antiker Kleinkunst 5, pl. 230.1, CVA online vase #203039; R-183, Bologna, Museo Civico Archeologico PU274, ARV 793, 78, CVA Italia 5 Bologna, Museo Civico 1 (III.I.c), pl. 16.1, CVA online vase #209786.

Examples of elaborately decorated armor: B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779; R-39, Paris, Musée du Louvre G197, ARV 238, 1, CVA France 9 Louvre 6 (III.I.c), pl. 35.6–7, CVA online vase #202176; R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829; R-190, Geneva, Musée d'Art et d'Histoire MF238, ARV 615, 1, CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pl. 14.3, CVA online vase #207115; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-203, Cambridge, Fitzwilliam Museum 11.17, ARV 1070, 4, CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.I), pls. 33.1a, 40.2, CVA online vase #214410; R-222, Ferrara, Museo Nazionale di Spina 3031, ARV 612, 1, CVA Italia 37 Ferrara, Museo Nazionale 1, pls. 9.1–4, 10.1–4, CVA online vase #207095; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987.

Throughout this chapter, we have attempted in the notes to give examples of the various phenomena being discussed with both citations of the artifact itself and references to a photograph of it in a standard publication. For practical reasons of space, we normally offer just some representative examples, but it should be kept in mind that these do not constitute a comprehensive list.

2. Examples of squared shoulder flaps: R-6, Vienna, Kunsthistorisches Museum 654, ARV 201, 67, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 54.2, CVA online vase #201875; R-29, Vienna, Kunsthistorisches Museum 3725, ARV 204, 109, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 68.2, CVA online vase #201917; R-34, Würzburg, Martin von Wagner Museum L507, ARV 181, 1, CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pl. 8.1, CVA online vase #201654; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821; R-187, London, British Museum E448, ARV 992, 65, CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a, CVA online vase #213886; R-218, Bologna, Museo Civico Archeologico 289, ARV 891, Bologna 289, CVA Italia 27 Bologna, Museo Civico 4 (III. I), pls. 73.3–4, 74.7–8, CVA online vase #211752.

3. Examples of rounded shoulder flaps: R-5, Palermo, Museo Archeologico Regionale V667, ARV 211, 194, CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 20.1, CVA

online vase #202013; R-33, Munich, Antikensammlungen 2305, ARV 182, 4, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pl. 174.1, CVA online vase #201657; R-49, Basel, Antikenmuseum und Sammlung Ludwig BS453, ARV 1634, 30 bis, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2, CVA online vase #275091; R-99, Berlin, Antikensammlung F2287, ARV 433, 68, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 79.1, CVA online vase #205114; R-115, Munich, Antikensammlungen 2425, ARV 294, 65, CVA Deutschland 20 München, Museum Antiker Kleinkunst 5, pl. 230.1, CVA online vase #203039; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178, 179, 181 in Arias (1962), CVA online vase #206930; R-177, Berlin, Antikensammlung 3241, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 94.3, CVA online vase #1003937; R-186, New York, Metropolitan Museum of Art 07.286.81, ARV 991, 61, pl. 114 in Boardman (1989), CVA online vase #213882; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987.

4. On Persian armor, see Sekunda (1992). Examples of Persians wearing Type IV armor include: R-72, Orvieto, Faina Collection no. 48, in Sekunda (2002, 51); R-121, New York, Metropolitan Museum of Art 06.1021.117, pl. 46 in Snodgrass (1999), CVA online vase #275257; R-144, Berlin, Antikensammlung F2331, ARV 646, 7, pl. 360 in Boardman (1975), CVA online vase #207519; R-176, Basel, Antikenmuseum und Sammlung Ludwig BS480, CVA Schweiz 7 Basel, Antikenmuseum Basel und Sammlung Ludwig 3 (III.I), pls. 8.3–4, 9.3–4, CVA online vase #1287.

5. On Persian influences on Greek culture generally, especially as a consequence of the Persian Wars, see M. Miller (1997). She briefly discusses Greek and Persian body armor but focuses mainly on the issue of corselets featuring metal scales as a possible result of Persian influence (48–49).

6. Representative examples that lack visible ties: R-5, Palermo, Museo Archeologico Regionale V667, ARV 211, 194, CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 20.1, CVA online vase #202013; R-6, Vienna, Kunsthistorisches Museum 654, ARV 201, 67, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 54.2, CVA online vase #201875; R-29, Vienna, Kunsthistorisches Museum 3725, ARV 204, 109, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 68.2, CVA online vase #201917; R-64, Brussels, Musées Royaux R322, ARV 402, 17, CVA Belgique 1, Bruxelles, Musées Royaux du Cinquantenaire 1 (III.I.c), pl. 3.1b–d, CVA online vase #204358; R-115, Munich, Antikensammlungen 2425, ARV 294, 65, CVA Deutschland 20 München, Museum Antiker Kleinkunst 5, pl. 230.1, CVA online vase #203039.

7. Only instances where the ties and their attachment points are clearly visible were recorded for use in our analysis.

8. Representative examples of center attachment method: R-49, Basel, Antikenmuseum und Sammlung Ludwig BS453, ARV 1634, 30 bis, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2, CVA online vase #275091; R-98, Berlin, Antikensammlung F2288, ARV 438, 130, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 82.2, CVA online vase #205176; R-152, Palermo, Mormino Collection V676, ARV 641, 83, pl. 358 in Boardman (1975), CVA online vase #207435; R-203, Cambridge, Fitzwilliam Museum 11.17, ARV 1070, 4, CVA Great Britain 6 Cambridge, Fitzwilliam Museum

1 (III.I), pls. 33.1a, 40.2, CVA online vase #214410; R-219, Athens, Benaki Museum 38151, CVA Greece 9 Athens, Benaki Museum 1, pl. 3.2.

9. Representative examples of parallel attachment method: B-26, Vatican City, Museo Gregoriano Etrusco Vaticano G91, pl. 3.3 in Beazley (1947); B-41, Würzburg, Martin von Wagner Museum HA18, CVA Deutschland 51 Würzburg, Martin von Wagner Museum 3, pl. 45.1, CVA online vase #1005913; R-186, New York, Metropolitan Museum of Art 07.286.81, ARV 991, 61, pl. 114 in Boardman (1989), CVA online vase #213882; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987; P-5, François Tomb (one painted warrior), Rome, Museo Torlonia, pl. 266 in Giglioli (1935); P-7, Painting of warrior in "Bella Tumulus" tomb, Vergina; P-10, Alexander Mosaic, Naples, Museo Archeologico Nazionale; P-8, Warrior on facade of "Great Tomb" (Tomb 18C) at Lefkadia, pl. 8b in S. Miller (1993); S-47, Simitthus-Chemtou temple, Tunisia, pl. 22 in Polito (1998).

10. Representative examples of crossed method: R-121, New York, Metropolitan Museum of Art 06.1021.117, CVA online vase #275257; R-171, Bologna, Museo Civico Archeologico PU285, ARV 633, 6, CVA Italia 27 Bologna, Museo Civico 4 (III.I), pl. 78.3, CVA online vase #207341; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 179, 181 in Arias (1962), CVA online vase #206930 (on 3 different figures); R-213, Paris, Cabinet des Médailles 851, ARV 1251, 41, CVA online vase #216978; R-217, Oxford, Ashmolean Museum G138.14, ARV 1252, 49, CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pls. 14.25, 39.5, 43.13, CVA online vase #216986.

11. Representative examples of combined attachment method: R-185, Munich, Antikensammlungen 2688, ARV 879, 1, pl. 80.1 in Boardman (1989), CVA online vase #211565; R-218, Bologna, Museo Civico Archeologico 289, ARV 891, Bologna 289, CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 73.3–4, 74.7–8, CVA online vase #211752.

12. Representative examples of shoulder flap rings: T-3, Terracotta warrior from Temple of Juno Moneta, Museo Nazionale Etrusco di Villa Giulia, pl. 120, no. 424 in Andrén (1939); T-15, Warrior from Belvedere Temple, Orvieto, Museo dell'Opera del Duomo, pl. 64, no. 210 in Andrén (1939).

13. Examples of wheel-like attachment device: R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman (1975), CVA online vase #204546; R-187, London, British Museum E448, ARV 992, 65, CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a, CVA online vase #213886; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS 486, ARV 612, 2, CVA Schweiz 7 Basel, Antikenmuseum und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-202, Ferrara, Museo Nazionale di Spina 2895, ARV 601, 18, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 16.1, CVA online vase #206949; R-203, Cambridge, Fitzwilliam Museum 11.17, ARV 1070, 4, CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.I), pls. 33.1a, 40.2, CVA online vase #214410; R-221, Munich, Antikensammlungen 2359, ARV 1661, Munich 2359, CVA Deutschland 6 München, Museum Antiker Kleinkunst 2, pl. 73.1, CVA online vase #275293.

14. Examples of a double row of *pteruges*: R-3, London, British Museum E258, ARV 54, 4, pl. 57.2 in Boardman (1975), CVA online vase #200436; R-5, Palermo, Museo Archeologico Regionale V667, ARV 211, 194, CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 20.1, CVA online vase #202013; R-6, Vienna, Kunsthistorisches Museum 654, ARV 201, 67,

CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 54.2, CVA online vase #201875; R-7, Munich, Antikensammlungen 2588, ARV 162, 2, pl. 86 in Boardman (1975), CVA online vase #201515; R-8, Tarquinia, Museo Nazionale Tarquiniense RC2066, ARV 126, 23, CVA Italia 25 Tarquinia, Museo Nazionale Tarquiniense 1 (III.I), pl. 6.2, CVA online vase #201051; R-25, Arezzo, Museo Archeologico Nazionale 1465, ARV 15, 6, pl. 29 in Boardman (1975), CVA online vase #200068; R-33, Munich, Antikensammlungen 2305, ARV 182, 4, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pl. 174.1, CVA online vase #201657; R-34, Würzburg, Martin von Wagner Museum L507, ARV 181, 1, CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pl. 8.1, CVA online vase #201654; R-42, Agrigento, Museo Archeologico Regionale C1956, ARV 32, 2, pl. 70 in Woodford (1993), CVA online vase #200177; R-49, Basel, Antikenmuseum und Sammlung Ludwig BS453, ARV 1634, 30 bis, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2, CVA online vase #275091.

15. Examples of a single row of *pteruges*: R-78, Berlin, Antikensammlung F2295, ARV 364, 45, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 64.3–4, CVA online vase #203837; R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, fig. 135 in Boardman (1975), CVA online vase #201724; R-99, Berlin, Antikensammlung F2287, ARV 433, 68, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 79.1, CVA online vase #205114; R-109, Brussels, Musées Royaux R303, ARV 249, 6, CVA Belgique 1, Bruxelles, Musées Royaux du Cinquantenaire (III.I.c), pls. 8.a–d, 9b, CVA online vase #202485; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-126, Bryn Mawr College P218, ARV 830, 2, CVA USA 13 Bryn Mawr College 1, pl. 24.3, CVA online vase #210313; R-174, Edinburgh, National Museums of Scotland 1887.213, ARV 364, 46, CVA Great Britain 16 Edinburgh, The National Museums of Scotland, pls. 23.7–8, 24.1–4, CVA online vase #203838; R-178, Bologna, Museo Civico Archeologico 269, CVA Italia 33 Bologna, Museo Civico 5, pl. 102.2, CVA online vase #206936; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikenmuseum und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-202, Ferrara, Museo Nazionale di Spina 2895, ARV 601, 18, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 16.1, CVA online vase #206949.

16. Examples of single- and double-row *pteruges* occurring on the same vase: R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, pl. 135 in Boardman (1975), CVA online vase #201724; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, fig. 186 in Boardman (1975), CVA online vase #202631.

17. Examples of crenellated *pteruges*: R-166, Paris, Musée du Louvre G343, ARV 600, 17, CVA France 4 Louvre 3 (III.I.d), pl. 5.3, CVA online vase #206948; R-173, Ferrara, Museo Nazionale di Spina T113AVP, ARV 608, 3, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 8.1, CVA online vase #207046; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, CVA online vase #206930, pls. 176, 178, 179 in Arias (1962) (on two figures); R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikenmuseum und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096.

18. Examples of rounded scales: R-3, London, British Museum E258, ARV 54, 4, pl. 57.2 in Boardman (1975), CVA online vase #200436; R-39, Paris, Musée du Louvre G197,

ARV 238, 1, CVA France 9 Louvre 6, pl. 35.6–7, CVA online vase #202176; R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108; R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pls. 92, 96 in Woodford (1993), CVA online vase #205070; R-98, Berlin, Antikensammlung F2288, ARV 438, 130, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 82.2, CVA online vase #205176; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, fig. 186 in Boardman (1975), CVA online vase #202631; R-134, Paris, Musée du Petit Palais 868, ARV 592, 36, CVA France 15 Paris, Petit Palais, pl. 23.1, CVA online vase #206859; R-146, Warsaw, National Museum 142357, CVA Pologne 1, Goluchow, Musée Czartoryski (III.I.d), pl. 25c, CVA online vase #215493; R-178, Bologna, Museo Civico Archeologico 269, ARV 599, 8, CVA Italia 33 Bologna, Museo Civico 5, pl. 102.2, CVA online vase #206936; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987.

19. Examples of square scales: W-4, Palermo, Museo Archeologico Regionale 1886, ARV 446, 266, pl. 299 in Carpenter (1991), CVA online vase #205315; R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pl. 92 in Woodford (1993), CVA online vase #205070; R-77, Paris, Musée du Louvre G115, ARV 434, 74, pl. 144 in Arias (1962), pl. 305 in Carpenter (1991), CVA online vase #205119; R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman (1975), CVA online vase #204546; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-124, London, British Museum E263, ARV 594, 54, CVA Great Britain 4 London, British Museum 3, pl. 6.2a, CVA online vase #206878; R-166, Paris, Musée du Louvre G343, ARV 600, 17, CVA France 4 Louvre 3 (III.I.d), pl. 5.3, CVA online vase #206948; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178, 181 in Arias (1962), CVA online vase #206930; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821; R-185, Munich, Antikensammlungen 2688, ARV 879, 1, pl. 80.1 in Boardman (1989), CVA online vase #211565; R-218, Bologna, Museo Civico Archeologico 289, ARV 891, Bologna 289, CVA Italia 27 Bologna, Museo Civico 4 (III, I), pls. 73.3–4, 74.7–8, CVA online vase #211752.

20. The Olympia scales are bronze plated with silver and were no doubt part of an exceptionally expensive suit of armor (Furtwängler 1890, 158). The Delphi scales seem to have come from a corselet in which bronze and iron scales alternated (Snodgrass 1964, 85). Other scales have been found at Philia, Troy, Mycenae, and Lefkandi (Jarva 1995, 38; Kilian 1983, 140). See also the fifth-century B.C. fragment of a scaled corselet of Greek or Scythian origin found in the Crimea and now at the Ashmolean (Gardner 1884, 65–66, and Vickers 2002, 44–45) and the cache of 3,500 scales reported by Reinach (1892, 75).

21. In our reconstructions, we did not add extra scales, but a sense of what corselets with such scales might have looked like is provided by the reconstructions of Dimitrios Katsikis of the reenactor group Korybantes. His work can be viewed at http://hellenicarmors.gr/. The vase painting in figure 2.8 was the inspiration for his reconstruction depicted at http://hellenicarmors.gr/products.php?pageId=15. This particular corselet is covered with 1,300 metal scales.

22. Example of scales covering the entire corselet: R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108.

Examples of scales on both sides: R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman (1975), CVA online vase #204546; R-98, Berlin, Antikensammlung F2288, ARV 438, 130, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 82.2, CVA online vase #205176; R-106, Oxford, Ashmolean Museum 1911.615, ARV 399, Oxford 1911.615, CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pl. 2.1, CVA online vase #204329; R-166, Paris, Musée du Louvre G343, ARV 600, 17, CVA France 4 Louvre 3 (III.I.d), pl. 5.3, CVA online vase #206948; R-134, Paris, Musée du Petit Palais 868, ARV 592, 36, CVA France 15 Paris, Petit Palais, pl. 23.1, CVA online vase #206859; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821.

Examples of scales on the chest: R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pl. 92 in Woodford (1993), CVA online vase #205070; R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman (1975), CVA online vase #204546; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-173, Ferrara, Museo Nazionale di Spina T113AVP, ARV 608, 3, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 8.1, CVA online vase #207046; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-194, Bologna, Museo Civico Archeologico 279, ARV 612, 3, CVA Italia 27 Bologna, Museo Civico 4, pls. 64.7, 66.12, CVA online vase #207097; R-222, Ferrara, Museo Nazionale di Spina 3031, ARV 612, 1, CVA Italia 37 Ferrara, Museo Nazionale 1, pls. 9.1–4, 10.1–4, CVA online vase #207095; R-225, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 21.3–4.

Examples of scales on the abdomen: R-3, London, British Museum E258, ARV 54, 4, pl. 57.2 in Boardman (1975), CVA online vase #200436; R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-44, New York, Metropolitan Museum of Art 41.162.1, CVA USA 1 Hoppin and Gallatin Collections/Gallatin Collection (III.I.c), pl. 10.1; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-146, Warsaw, National Museum 142357, CVA Pologne 1, Goluchow, Musée Czartoryski (III.I.d), pl. 25c, CVA online vase #215493; R-166, Paris, Musée du Louvre G343, ARV 600, 17, CVA France 4 Louvre 3 (III.I.d), pl. 5.3, CVA online vase #206948; R-178, Bologna, Museo Civico Archeologico 269, CVA Italia 33 Bologna, Museo Civico 5, pl. 102.1–2, CVA online vase #206936; R-194, Bologna, Museo Civico Archeologico 279, ARV 612, 3, CVA Italia 27 Bologna, Museo Civico 4, pls. 64.8, 65.10, 66.12, CVA online vase #207097; R-202, Ferrara, Museo Nazionale di Spina 2895, ARV 601, 18, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 16.1–2, CVA online vase #206949.

Examples of scales on the *pteruges*: R-39, Paris, Musée du Louvre G197, ARV 238, 1, CVA France 9 Louvre 6 (III.I.c), pl. 35.6–7, CVA online vase #202176; R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108; R-106, Oxford, Ashmolean Museum 1911.615, ARV 399, Oxford 1911.615, CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pl. 2.1, CVA online vase #204329.

Examples of scales on the shoulder flaps: B-9, Boston, Museum of Fine Arts 01.8027, ABV 152, 27, CVA USA 14 Museum of Fine Arts, Boston 1 (III.H), pl. 27.2, CVA online vase #310454; R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman

(1975), CVA online vase #204546; R-118, Mannheim, Reiss-Engelhorn-Museen 124, ARV 447, 276, CVA Deutschland 13 Mannheim, Reiss-Engelhorn-Museen 1, pl. 26.6, CVA online vase #205324.

23. In Greek depictions, only clear instances were counted as scales, as, for example, when there was plain evidence of overlapping. This means that very crude depictions in which there was only a rudimentary grid pattern visible that could represent any number of things—perhaps scales, painted decorations, or a woven design—were not counted. Thus, depending on what these unclear images were intended to show, the total percentage of armor with scales may be somewhat higher than we have indicated. Nevertheless, the general conclusion that most Greek armor did not have scales would remain unchanged. Because a much higher percentage of Etruscan examples do seem to include some form of added scales, there are plainly two separate styles and traditions of armor at work here, and lumping them together would result in distorted and unrepresentative statistics. Because of the sharp differences between Greek and Etruscan Type IV armor, this chapter mostly treats the two traditions separately. Trends in Etruscan structural variants and decorative elements are examined in a separate section at the end of the chapter.

24. Typifying this assumption is the comment by Schwartz (2009, 72) that "often the corselets were reinforced with metal such as bronze scales." Given that some of the most famous vases depicting Type IV armor are ones in which scales are present, such conclusions were understandable. Until we counted the images and realized how relatively rare scales were, we too had assumed that scales were much more common.

25. It has occasionally been suggested that scaled corselets were typical of Eastern civilizations such as Persia and that the Greeks may have been influenced to adopt more scaled armor after the Persian Wars (see M. Miller, 1997, 48–49; Snodgrass 1967, 90–91). While scaled corselets on vase paintings may be more prevalent in the fifth century B.C. than earlier, the evidence is not pronounced enough to constitute a clear trend, and it seems more likely that scales had always been an option.

26. On the delicacy of scale corselets and the tendency for the scales to come undone, see Croom (2000). Although such armor would have needed frequent tending in the field, simply resewing scales that had fallen off can be a fairly simple, if time-consuming, process that would not have required the services of a specialist. This maintenance work might have been done by the soldiers themselves (or their servants). If the scales themselves were damaged, then more specialist metalworking skills would have been necessary. In personal correspondence with members of the Korybantes hoplite reenactor group, who make extensive use of scales attached to linen armor, they reported that after about a week of wearing the armor in field conditions, typically about 20–30 scales per suit of armor will have broken off or become damaged, requiring repair.

27. For insights on keeping ancient military equipment free of rust, see Leslie and Croom (1996).

28. The issues of the cost and weight of scales are discussed in more detail in chapters 7 and 8.

29. Examples of horizontal waistband with crosshatching: B-5, Bologna, Museo Civico Archeologico GM6, ABV 200, 10, CVA Italia 7 Bologna, Museo Civico 2 (III.H.e), pl. 30.1, CVA online vase #302587; B-7, Basel, Antikenmuseum und Sammlung Ludwig BS1953.8,

ABV 68, 1, CVA Schweiz 4 Basel, Antikenmuseum 1 (III.H), pl. 25.2, CVA online vase #300617; B-18, Athens, National Museum 18836, ABV 201, 18, CVA Greece 4 Athens, National Museum 4, pl. 16.1–2, CVA online vase #302595; B-23, Liverpool, Public Museums 49.50.4, CVA online vase #350869; B-30, Rome, Capitoline Museum, black-figure olpe no. 6A, ABV 176, CVA Italia 36 Roma, Musei Capitolini 1 (III.H), pl. 28.3–4, CVA online vase #306449; B-40, Malibu, CA, J. Paul Getty Museum 83.AE.346, CVA USA 34 J. Paul Getty Museum 9 (Caeretan III.Fa), pl. 498.1, CVA online vase #1002891; W-4, Palermo, Museo Archeologico Regionale 1886, ARV 446, 266, pl. 299 in Carpenter (1991), CVA online vase #205315; R-8, Tarquinia, Museo Nazionale Tarquiniense RC2066, ARV 126, 23, CVA Italia 25 Tarquinia, Museo Nazionale Tarquiniense 1 (III.I), pl. 6.2, CVA online vase #201051; R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108; R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pl. 96 in Woodford (1993), CVA online vase #205070.

30. See the fuller discussion of these corselets, with relevant bibliography, in chapter 1.

31. *Iliad* 4.132ff. and 7.305. See also Herodotus 9.74.

32. The assumption about the *zoster* possessing metal plates may have arisen from misreadings of the most famous mention of a *zoster*. This occurs in Homer's *Iliad* when Menelaus is shot with an arrow that penetrates through his *zoster*, *mitre*, and corselet (4.125ff.). The *mitre* is identifiable as a metal abdomen guard, such as those found at Olympia, which Homer specifically states was the work of coppersmiths (4.187). (On the *mitre*, see Jarva 1995, 51–60). At 4.186, Menelaus does describe his *zoster* as "flashing," but this is plainly a reference to the clasps that secure its ends, which are repeatedly identified as being made of gold. In fact, Athena is explicitly portrayed as guiding the arrow so that it strikes these metal clasps, dissipating the force of the blow so that Menelaus suffers only a flesh wound. While the clasps of this *zoster* are therefore made of metal, there is nothing in the text indicating what material the *zoster* itself is composed of.

33. On the linguistic *zoster/zona* connection, its woven nature, and its symbolic value for women, see Barber (1994, 54–70, and especially 65–66). Also discussed in more scattered form in Barber (1991).

34. Representative examples of simple stars: B-3, Paris, Musée du Louvre F25, ABV 150, 4, CVA France 4 Paris, Musée du Louvre 3 (III.H.e), pl. 16.4, CVA online vase #310431; R-39, Paris, Musée du Louvre G197, ARV 238, 1, CVA France 9 Louvre 6 (III.I.c), pl. 35.6–7, CVA online vase #202176; R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, pl. 135 in Boardman (1975), CVA online vase #201724; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-123, London, British Museum E469, ARV 589, 1, pl. 10 in Boardman (1989), CVA online vase #207137; R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829.

Representative examples of elaborate stars: R-18, Amsterdam, Allard Pierson Museum 3361, ARV 149, 8, CVA The Netherlands 6 Amsterdam, Allard Pierson Museum 1 (III.I), pl. 15.2a; R-124, London, British Museum E263, ARV 594, 54, CVA Great Britain 4 London, British Museum 3, pl. 6.2a, CVA online vase #206878; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178 in Arias (1962), CVA online vase #206930; R-178, Bologna, Museo Civico Archeologico 269, CVA Italia 33 Bologna, Museo

Civico 5, pl. 102.1–2, CVA online vase #206936; R-185, Munich, Antikensammlungen 2688, ARV 879, 1, pl. 80.1 in Boardman (1989), CVA online vase #211565; R-207, Vienna, Kunsthistorisches Museum 853, ARV 1054, 53, CVA Österreich 3 Wien, Kunsthistorisches Museum 3 (III.I), pl. 113.3, CVA online vase #213683.

35. Representative examples of stars on shoulder flaps: B-3, Paris, Musée du Louvre F25, ABV 150, 4, CVA France 4 Paris, Musée du Louvre 3 (III.H.e), pl. 16.4, CVA online vase #310431; B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779; R-18, Amsterdam, Allard Pierson Museum 3361, ARV 149, 8, CVA The Netherlands 6 Amsterdam, Allard Pierson Museum 1 (III.I), pl. 15.2a; R-39, Paris, Musée du Louvre G197, ARV 238, 1, CVA France 9 Paris, Musée du Louvre 6 (III.I.c), pl. 35.6–7, CVA online vase #202176; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-123, London, British Museum E469, ARV 589, 1, pl. 10 in Boardman (1989), CVA online vase #207137; R-124, London, British Museum E263, ARV 594, 54, CVA Great Britain 4 London, British Museum 3, pl. 6.2a, CVA online vase #206878; R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178, 179, 181 in Arias (1962), CVA online vase #206930; R-178, Bologna, Museo Civico Archeologico 269, CVA Italia 33 Bologna, Museo Civico 5, pl. 102.1–2, CVA online vase #206936; R-203, Cambridge, Fitzwilliam Museum 11.17, ARV 1070, 4, CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.I), pls. 33.1a, 40.2, CVA online vase #214410; R-219, Athens, Benaki Museum 38151, CVA Greece 9 Athens, Benaki Museum 1, pl. 3.2.

36. Representative examples of stars on the torso: R-124, London, British Museum E263, ARV 594, 54, CVA Great Britain 4 London, British Museum 3, pl. 6.2a, CVA online vase #206878; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pl. 181 in Arias (1962), CVA online vase #206930 (on two figures); R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-219, Athens, Benaki Museum 38151, CVA Greece 9 Athens, Benaki Museum 1, pl. 3.2.

Representative examples of stars on the back: R-44, New York, Metropolitan Museum of Art 41.162.1, CVA USA 1 Hoppin and Gallatin Collections/Gallatin Collection (III.I.c), pl. 10.1; R-48, Basel, Antikenmuseum und Sammlung Ludwig BS472, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pl. 7.3, CVA online vase #9919; R-74, Berlin, Antikensammlung F2293, ARV 370, 10, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 67.2; R-76, Cleveland Museum of Art, 1978.59, CVA USA 35 Cleveland Museum of Art 2, pl. 70.3, CVA online vase #5168; R-103, Würzburg, Martin von Wagner Museum L508, ARV 182, 5, CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pl. 12.2, CVA online vase #201658; R-198, Kiel, Antikensammlung B52, CVA Deutschland 55 Kiel, Kunsthalle, Antikensammlung 1, pl. 50.5, 50.7, CVA online vase #30082.

37. Example of stars on the *pteruges*: R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, pl. 135 in Boardman (1975), pl. 144 in Boardman et al. (1967), CVA online vase #201724.

38. Examples of many-pointed stars: R-100, Vienna, Kunsthistorisches Museum 3724, ARV 280, 9, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 52.2, CVA

online vase #202712; R-103, Würzburg, Martin von Wagner Museum L508, ARV 182, 5, CVA Deutschland 46 Würzburg, Martin von Wagner Museum 2, pls. 12.2, 13.2, CVA online vase #201658; R-221, Munich, Antikensammlungen 2359, ARV 1661, Munich 2359, CVA Deutschland 6 München, Museum Antiker Kleinkunst 2, pl. 73.1, CVA online vase #275293.

39. Representative examples of eight-point stars: R-33, Munich, Antikensammlungen 2305, ARV 182, 4, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pl. 174.1, CVA online vase #201657; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178, 181 in Arias (1962), CVA online vase #206930; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821; R-187, London, British Museum E448, ARV 992, 65, CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a, CVA online vase #213886; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-203, Cambridge, Fitzwilliam Museum 11.17, ARV 1070, 4, CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.I), pls. 33.1a, 40.2, CVA online vase #214410; R-212, Madrid, Museo Arqueológico Nacional 11113, ARV 1193, 2, CVA Espagne 2 Madrid, Museo Arqueológico Nacional 2 (III.I.c), pl. 21.4a, CVA online vase #215784.

40. Examples of four-point stars: B-3, Paris, Musée du Louvre F25, ABV 150, 4, CVA France 4 Paris, Musée du Louvre 3 (III.H.e), pl. 16.4, CVA online vase #310431; R-62, Harrow, School Museum 50, ARV 516, 5, pl. 37 in Boardman (1989), CVA online vase #205793; R-74, Berlin, Antikensammlung F2293, ARV 370, 10, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 67.2; R-152, Palermo, Mormino Collection V676, ARV 641, 83, pl. 358 in Boardman (1975), CVA online vase #207435; R-161, Athens, National Museum 1644, ARV 310, 19, CVA online vase #203189; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 179, 181 in Arias (1962), CVA online vase #206930; R-201, New York, Metropolitan Museum of Art 08.258.21, ARV 1086, 1, pl. 184 in Boardman (1989), CVA online vase #214585; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987.

Examples of 16-point stars: R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-143, Paris, Musée du Louvre G165, ARV 601, 21, CVA France 2 Paris, Musée du Louvre 2 (III.I.c), pl. 23.6, CVA online vase #206952; R-191, Bochum, Ruhr-Universität, Kunstsammlungen S1060, CVA Deutschland 81 Bochum, Kunstsammlungen der Ruhr-Universität 2, pl. 5.2, CVA online vase #6974.

41. Example of a six-point star: R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pl. 96 in Woodford (1993), pl. 285.2 in Boardman (1975), CVA online vase #205070.

Examples of a nine-point star: R-36, Lausanne, private collection, ARV 471, 185, pl. 315 in Boardman (1975), CVA online vase #204868; R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829; R-190, Geneva, Musée d'Art et d'Histoire MF238, ARV 615, 1, CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pl. 14.3, CVA online vase #207115.

42. Examples of two stars on armor: R-161, Athens, National Museum 1644, ARV 310, 19, CVA online vase #203189; R-173, Ferrara, Museo Nazionale di Spina T113AVP, ARV 608, 3, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 8.1, CVA online vase #207046; R-225, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 21.3–4.

43. Examples of central chest star plus two shoulder stars: R-124, London, British Museum E263, ARV 594, 54, CVA Great Britain 4 London, British Museum 3, pl. 6.2a, CVA online vase #206878; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pl. 181 in Arias (1962), CVA online vase #206930 (on two figures); R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096; R-219, Athens, Benaki Museum 38151, CVA Greece 9 Athens, Benaki Museum 1, pl. 3.2.

44. Examples of armor with more than three stars: R-11, Rome, Museo Nazionale Etrusco di Villa Giulia 3577, CVA Italia 1 Rome, Museo Nazionale Etrusco di Villa Giulia 1 (III.I.c), pl. 3.2, CVA online vase #2352 (four); R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096 (four).

45. Examples of a single star on armor: R-74, Berlin, Antikensammlung F2293, ARV 370, 10, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 67.2, 68.4; R-113, Boston, Museum of Fine Arts 97.368, ARV 290, 1, pl. 186 in Boardman (1975), CVA online vase #202631; R-186, New York, Metropolitan Museum of Art 07.286.81, ARV 991, 61, pl. 114 in Boardman (1989), CVA online vase #213882.

46. Examples of dots: R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-38, Naples, Museo Archeologico Nazionale H2410, ARV 239, 18, pl. 170 in Boardman (1975), CVA online vase #202367; R-39, Paris, Musée du Louvre G197, ARV 238, 1, CVA France 9 Paris, Musée du Louvre 6 (III.I.c), pl. 35.6–7, CVA online vase #202176; R-49, Basel, Antikenmuseum und Sammlung Ludwig BS453, ARV 1634, 30 bis, CVA Schweiz 6 Basel, Antikenmuseum und Sammlung Ludwig 2 (III.I), pls. 44.1, 45, 46.1–2, CVA online vase #275091; R-78, Berlin, Antikensammlung F2295, ARV 364, 45, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 64.3–4, CVA online vase #203837; R-109, Brussels, Musées Royaux R303, ARV 249, 6, CVA Belgique 1, Bruxelles, Musées Royaux du Cinquantenaire (III.I.c), pls. 8a–d, 9b, CVA online vase #202485; R-174, Edinburgh, National Museums of Scotland 1887.213, ARV 364, 46, CVA Great Britain 16 Edinburgh, The National Museums of Scotland, pls. 23.7–8, 24.1–4, CVA online vase #203838; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 181 in Arias (1962), CVA online vase #206930.

Examples of zigzags: B-8, Athens, National Museum 12667, ABV 65, 33, CVA Greece 3 Athens, National Museum 3, pls. 14.3A, 15.3B, CVA online vase #300577; B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779; R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-78, Berlin, Antikensammlung F2295, ARV 364, 45, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 64.3–4, CVA online vase #203837; R-98, Berlin, Antikensammlung F2288, ARV 438, 130, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 82.2, CVA online vase #205176; R-174, Edinburgh, National Museums of Scotland 1887.213, ARV 364, 46, CVA Great Britain 16 Edinburgh, The National Museums of Scotland, pls. 23.7–8, 24.1–4, CVA online vase #203838; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), Pl. 5.1–4, CVA online vase #207096; R-194, Bologna, Museo Civico Archeologico 279, ARV 612, 3, CVA Italia 27

Bologna, Museo Civico 4, pls. 64.8, 65.10, 66.12, CVA online vase #207097; R-202, Ferrara, Museo Nazionale di Spina 2895, ARV 601, 18, CVA Italia 37 Ferrara, Museo Nazionale 1, pl. 16.1–2, CVA online vase #206949; R-222, Ferrara, Museo Nazionale di Spina 3031, ARV 612, 1, CVA Italia 37 Ferrara, Museo Nazionale 1, pls. 9.1–4, 10.1–4, CVA online vase #207095.

Examples of squares/checkerboard: B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779; R-106, Oxford, Ashmolean Museum 1911.615, ARV 399, Oxford 1911.615, CVA Great Britain 3 Oxford, Ashmolean Museum 1 (III.I), pl. 2.1, CVA online vase #204329; R-118, Mannheim, Reiss-Engelhorn-Museen 124, ARV 447, 276, CVA Deutschland 13 Mannheim, Reiss-Engelhorn-Museen 1, pl. 26.6, CVA online vase #205324; R-130, Rome, Museo Nazionale Etrusco di Villa Giulia 46942, CVA Italia 64 Roma, Museo Nazionale Etrusco di Villa Giulia 4, pl. 23.1, CVA online vase #17982 (panel on chest); R-181, London, British Museum E333, ARV 842, 116, CVA Great Britain 7 British Museum 5 (III.I.c), pl. 64.2a, CVA online vase #212264; R-191, Bochum, Ruhr-Universität, Kunstsammlungen S1060, CVA Deutschland 81 Bochum, Kunstsammlungen der Ruhr-Universität 2, pl. 5.2, CVA online vase #6974.

Examples of Greek key: B-38, Florence, Museo Archeologico Nazionale 3803, CVA Italia 42 Firenze, Museo Nazionale 5 (III-H), pl. 27.1, CVA online vase #8102; R-7, Munich, Antikensammlungen 2588, ARV 162, 2, pl. 86 in Boardman (1975), CVA online vase #201515; R-10, London, British Museum E41, ARV 58, 51, pl. 68.4 in von Bothmer (1957), CVA online vase #200441; R-25, Arezzo, Museo Archeologico Nazionale 1465, ARV 15, 6, pl. 29 in Boardman (1975), CVA online vase #200068; R-29, Vienna, Kunsthistorisches Museum 3725, ARV 204, 109, CVA Österreich 2 Wien, Kunsthistorisches Museum 2 (III.I), pl. 68.2, CVA online vase #201917; R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108; R-91, Cambridge, Fitzwilliam Museum 37.16, ARV 155, 37, CVA Great Britain 11 Cambridge, Fitzwilliam Museum 2 (Ricketts and Shannon Collection III.I), pl. 6.1b, CVA online vase #201440; R-99, Berlin, Antikensammlung F2287, ARV 433, 68, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 79.1, CVA online vase #205114; R-115, Munich, Antikensammlungen 2425, ARV 294, 65, CVA Deutschland 20 München, Museum Antiker Kleinkunst 5, pl. 230.1, CVA online vase #203039; R-187, London, British Museum E448, ARV 992, 65, CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a, CVA online vase #213886; R-215, Gravina, Museum 177009, CVA online vase #8063; R-229, Naples, Museo Archeologico Nazionale 81324, ARV 1252, 50, pl. 85a–f in von Bothmer (1957), CVA online vase #216987; S-4, Aristion monument, Athens, National Museum 29.

Examples of stripes on the *pteruges*: R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pls. 92, 96 in Woodford (1993), CVA online vase #205070; R-78, Berlin, Antikensammlung F2295, ARV 364, 45, CVA Deutschland 21 Berlin, Antiquarium 2, pl. 64.3–4, CVA online vase #203837; R-92, Paris, Cabinet des Médailles 573, ARV 417, 1, pl. 280.2 in Boardman (1975), CVA online vase #204546; R-174, Edinburgh, National Museums of Scotland 1887.213, ARV 364, 46, CVA Great Britain 16 Edinburgh, The National Museums of Scotland, pls. 23.7–8, 24.1–4, CVA online vase #203838; R-177, Berlin, Antikensammlung 3241, CVA Deutschland 21 Berlin, Antiquarium

2, pl. 94.3, CVA online vase #1003937; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821; R-187, London, British Museum E448, ARV 992, 65, CVA Great Britain 4 British Museum 3 (III.I.c), pl. 22.3a, CVA online vase #213886; R-193, Basel, Antikenmuseum und Sammlung Ludwig BS486, ARV 612, 2, CVA Schweiz 7 Basel, Antikensammlung und Sammlung Ludwig 3 (III.I), pl. 5.1–4, CVA online vase #207096.

47. Examples of Gorgon heads: R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pl. 179 in Arias (1962), CVA online vase #206930; R-182, Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821; R-226, London, British Museum 98.7-15.1, ARV 1048, 35, CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 25.1e, CVA online vase #213604; S-37, Tomb relief, Taranto, Museo Nazionale 113.768, fig. 533 in Carratelli et al. (1983); S-46, Relief in Paestum Museum, pl. 44 in Polito (1998); S-51, Relief of weapons on Temple of Athena Polias, Berlin, Pergamon Museum; S-58, Gravestone of Ariston and Gykeia, Istanbul Archaeological Museum inv. 3980 T; P-10, Alexander Mosaic, Naples, Museo Archeologico Nazionale.

48. On the symbolic meanings and function of the Gorgon head design, see Howe (1954). On the symbolism of these sorts of emblems in Greek culture generally, especially as shield devices, see Spier (1990).

49. Examples of animals: B-37, Bologna, Museo Civico Archeologico GM3, CVA Italia 7 Bologna, Museo Civico 2 (III.He), pl. 12.3, CVA online vase #14388 (panther heads on shoulder flaps); R-89, Naples, Museo Archeologico Nazionale H2422, ARV 189, 74, pl. 135 in Boardman (1975), CVA online vase #201724 (dual panther heads on back piece); R-218, Bologna, Museo Civico Archeologico 289, ARV 891, Bologna 289, CVA Italia 27 Bologna, Museo Civico 4 (III. I), pl. 74.8, CVA online vase #211752 (panther or lion head on chest); S-4, Aristion stele, Athens, National Museum (lion heads on shoulder flaps); R-167, Boston, Museum of Fine Arts 59.176, ARV 590, 11, pl. 102 in Woodford (1993), CVA online vase #206829 (possible lion head on shoulder flaps); R-25, Arezzo, Museo Archeologico Nazionale 1465, ARV 15, 6, pl. 29 in Boardman (1975), CVA online vase #200068 (lion silhouette); R-75, Paris, Musée du Louvre G152, ARV 369, 1, pl. 145 in Boardman et al. (1967), CVA online vase #203900 (snakes on shoulder flaps); R-85, Munich, Antikensammlungen 2640, ARV 402, 22, pl. 268 in Boardman (1975), CVA online vase #204363 (snakes on shoulder flaps); R-110, Paris, Musée du Louvre G228, ARV 250, 14, CVA France 9 Paris, Musée du Louvre 6 (III.I.c), pl. 45.8, CVA online vase #202517 (snakes on shoulder flaps); R-81, Vatican City, Museo Gregoriano Etrusco Vaticano 16583, ARV 373, 48, fig. 12 in Jarva (1995), CVA online vase #203946 (snakes on shoulder flaps); R-247, Athens, National Museum, red-figure vase fragment (single large snake on back piece); B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779 (one or possibly two animal heads on two different corselets).

50. Example: R-190, Geneva, Musée d'Art et d'Histoire MF238, ARV 615, 1, CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pl. 14.3, CVA online vase #207115 (silhouette of a man running on the shoulder flaps).

51. For example, Schwartz (2009, 70) suggests that the linothorax "is represented in vase painting by a relatively rare bright white."

Examples of white Type IV: B-1, Mainz, Johannes Gutenberg Universität 89, CVA Deutschland 15 Mainz, Universität 1, pl. 42.1, CVA online vase #350151; B-2, Paris, Musée du Louvre E642, pl. 39.2 (no. 1447) in Payne (1971), CVA online vase #9019335; B-4, Taranto, Museo Nazionale 20137, ABV 112, 65, CVA Italia 35 Taranto, Museo Nazionale 3 (III.H), pl. 23.1, CVA online vase #310211; B-8, Athens, National Museum 12667, ABV 65, 33, CVA Greece 3 Athens, National Museum 3, pls. 14.3A, 15.3B, CVA online vase #300577; B-10, Paris, Musée du Louvre F75, ABV 156, 81, pl. 26.2 in Beazley (1964), CVA online vase #310510; B-13, Cambridge, MA, Harvard University, Arthur M. Sackler Museum 60.318, ABV 86, 4, CVA USA 4 Baltimore, Robinson Collection 1 (III.E), pl. 18.1, CVA online vase #300793; B-20, Paris, Cabinet des Médailles 207, CVA France 7 Paris, Bibliothèque Nationale 1 (III.H.e), pl. 34.5, CVA online vase #320385; B-23, Liverpool, Public Museums 49.50.4, CVA online vase #350869; B-24, Marzabotto, collection unknown, CVA online vase #350870; B-25, Warsaw, National Museum 142457, CVA Pologne 1 Goluchow, Musée Czartoryski (III.He), pl. 10.1b, CVA online vase #14236; B-27, Athens, National Museum 433, ABV 120, 5, CVA online vase #300865; B-29, Heidelberg, Ruprecht-Karls-Universität 264, ABV 689, 6 bis, CVA Deutschland 10 Heidelberg, Universität 1, pl. 40.9, CVA online vase #306573; B-31, Orvieto, Museo Civico, Coll. Faina 2547, CVA Italia 41 Orvieto, Museo C. Faina 1 (III-H), pl. 5.3, CVA online vase #8048; B-33, Athens, National Museum 661, ABV 200, 11, CVA Greece 3 Athens, National Museum 3, pl. 43.1–2, CVA online vase #302588; B-35, Laon, Musée Archéologique Municipal 37.982, CVA France 20 Musée de Laon 1 (III.H), pl. 21.6, CVA online vase #12373; B-36, Cambridge, Fitzwilliam Museum GR6.1917, ABL 202, 24, CVA Great Britain 6 Cambridge, Fitzwilliam Museum 1 (III.H), pl. 22.26, CVA online vase #472; B-39, Munich, Antikensammlungen 1411, CVA Deutschland 3 München, Museum Antiker Kleinkunst 1 (III.H), pl. 43.2, CVA online vase #301594; B-42, Chiusi, Museo Archeologico Nazionale 1794, ABV 330, 1, CVA Italia 59 Chiusi, Museo Archeologico Nazionale 1, pl. 19.1–2, CVA online vase #301779; B-43, New York, Metropolitan Museum of Art 56.171.25, CVA USA 16 New York, Metropolitan Museum of Art 4 (III.H), pl. 51.1, CVA online vase #305529; B-44, University of Missouri–Columbia, Museum of Art and Archaeology 58.12, CVA USA 36 University of Missouri–Columbia, Museum of Art and Archaeology 1, pl. 25.3, CVA online vase #2933; B-45, Göttingen, University Archaeological Institute K325, CVA Deutschland 83 Göttingen, Archäologisches Institut der Universität 3, pl. 59.2.

A parallel argument that instances when the armor is painted red can be taken as an indication of the use of leather has similar problems of inconsistency.

52. A few examples of white being used for nonfabric elements include: B-22, Caltanisetta, Museo Civico 20372, CVA online vase #350763 (various white elements); B-25, Warsaw, National Museum 142457, CVA Pologne 1 Goluchow, Musée Czartoryski (III.He), pl. 10.1b, CVA online vase #14236 (shield and greaves); B-44, University of Missouri–Columbia, Museum of Art and Archaeology 58.12, CVA USA 36 University of Missouri–Columbia, Museum of Art and Archaeology 1, pl. 25.3, CVA online vase #2933 (white shield and helmet crest); B-45, Göttingen, University Archaeological Institute K325, CVA Deutschland 83 Göttingen, Archäologisches Institut der Universität 3, pl. 59.2 (various white elements); B-47, Warsaw, National Museum 198092, CVA Pologne 9 Varsovie, Musée National 6 (IV.B), pl. 48.4, CVA online vase #1012361 (shield rim); R-208, Athens, National Museum 1700, ARV

1146, 50, pl. 176 in Boardman (1989), CVA online vase #215190 (a man's beard, helmet, and helmet crest).

53. Assuming that the natural color of ancient linen was white is a common mistake among modern authors. A representative example is Everson (2004, 150), who writes, "The entire body of a corselet could be woven from linen which had already been dyed and not left in the natural white" (see, similarly, p. 96).

54. Barber (1991, 14).

55. Barber (1991, 15).

56. Brinkmann, who has done the most comprehensive reconstruction of how this monument was originally painted, restores the color of the cuirass as a brown-yellow ochre ("braungelben ocker," Brinkmann and Wünsche 2004, 65). He assumes, however, that the material of the cuirass is leather and partially bases his reconstruction of the color on other examples of what he believes are Greek color depictions of leather.

57. The traces of the decorative scheme on this statue are, in most places, rather faint and may not be visible in a photograph of the statue taken from even a meter away. In person and up close, however, they are clear. The description of the designs on this statue is based on personal observations of the monument in the National Museum in Athens. The reconstructed colors listed are those identified by V. Brinkmann and others who have conducted analyses of the original paint scheme. Because of the way in which the pigments have faded over time, the colors of some of the paint traces visible today do not correspond to their original hues. For example, much of what Brinkmann reconstructs as blue paint now looks mostly reddish in tone. In describing the original colors, we have followed Brinkmann's reconstruction. While there is an element of speculation in the reconstruction of the colors, the shape and design of the patterns described above are definite. See Brinkmann (2003, especially 71–74 and pl. 148.1–13 with accompanying text), and Brinkmann and Wünsche (2004, 61–65 and pls. 86–98). For a general description of the various techniques and methodology used in his reconstructions of the colors of ancient Greek monuments, see Brinkmann and Wünsche (2004, 25–51). On the Aristion monument, see also Wiegartz (1996) and Richter (1961, 47).

58. On the Great Tomb, see Petsas (1966). On the Bella Tumulus, see Andronikos (1981, 1982, 1984, 1987). On the Agios Athanasios tomb, see Tsibidou-Avloniti (2002). On these tombs generally, see Fedak (1990), Brecoulaki (2006), and S. Miller (1993).

59. All of the figures mentioned in this paragraph can be conveniently viewed, with color traces clearly visible, in the many color photographs found in the museum guidebook on the sarcophagus by Pasinli (1997). Some of the decorative details described are derived from personal inspection of the monument and from Pasinli's text.

60. On the Alexander Mosaic, see Pfrommer (1998), Moreno (2001), and Cohen (2000).

61. Tomb of Orcus: P-2, pl. 248 in Giglioli (1935). Amazon Sarcophagus: P-3, pl. 238 in Giglioli (1935), pls. 212 and 214 in Sprenger and Bartoloni (1977). François Tomb: P-5, pl. 266 in Giglioli (1935).

62. Red dyes derived from various sources were some of the most readily available and the cheapest in the ancient world, and, perhaps most importantly, would have set the best in linen, so the frequent appearance of red in the visual depictions is not surprising. On the sources and use of ancient dyes, see Barber (1991).

63. Now in the British Museum. See database M-19, pl. 221.1 in Giglioli (1935), and pl. 106 in Goldscheider (1941).

64. Examples of large, overlapping, square scales: M-25, Bronze statuette from Lake Falterona, now in the British Museum, see pl. 105 in Goldscheider (1941); figures forming cist handle: M-58, Rome, Museo Nazionale di Villa Giulia, Inv. 25210, see Cist VII, Tav. XVII in Bordenache Battaglia and Emiliozzi (1979); figures forming cist handle: M-29, Rome, Museo Nazionale di Terme, see pl. 61 in Goldscheider (1941).

Possible examples of plates laid edge to edge: M-8, Left-hand figure on vase handle, pl. 294.2 in Giglioli (1935); T-14, Pedimental warrior, Belvedere Temple, Orvieto, Museo dell'Opera del Duomo, see pl. 65, no. 212 in Andrén (1939).

65. Because of its size and degree of detail, the Mars Todi (M-18) presents a particularly interesting example of Type IV armor. All the distinctive features of Type IV armor, including the shoulder flaps, *pteruges*, and upright neck guard, are clearly visible. It has a double parallel attachment point system, and the attachment points themselves are indicated by buttonlike knobs at the ends of the shoulder guards and two corresponding knobs on the chest. On the left side of the statue are two more of these buttonlike knobs, which must have been used to tie together the ends of the main section of the armor that wraps around the torso. The scales cover the entire surface of the corselet except for the very ends of the shoulder flaps and the *pteruges*.

66. One possible exception is the crowning terracotta warrior figure from a pediment at Caere (T-5), who appears to have a horizontal band consisting of four rows of scales encircling his lower torso. This feature, which is painted on, is represented by a series of squares with a dot in the center of each. The identification as scales is speculative because it is possible that these markings could also simply represent a painted band of decoration. The band is most clearly seen in a reconstructed drawing in Andrén (1939), pl. B, no. 2, and is visible in pl. 128 in Sprenger and Bartoloni (1977).

67. One possible exception is a partial torso with a pair of red eight-point stars on the shoulder flaps (T-12, Antiquarium Comunale of Rome, nos. 3363, 3378; see pl. 107, no. 382 in Andrén 1939). Several warriors on a cist lid (M-55, Ny Carlsberg Glyptotek, Inv. H. 241, H.I.N. 43) may also have stomach bands of scales. For an image, see Cist III, Tav. VII in Bordenache Battaglia and Emiliozzi (1979).

68. Representative examples of Greek key bands: M-5, Incised mirror in British Museum, see pl. 146 in Spivey (1997); M-54, Cist in Berlin Charlottenburg Staatliche Museen, Antiken-Abteilung Inv. Misc. 6236, see Cist I, Tav. II in Bordenache Battaglia and Emiliozzi (1979); M-67, Cist in Museé des Beaux Arts, Lyon, Inv. E-154, see Cist 26, Tav. CXXVIII in Bordenache Battaglia and Emiliozzi (1979); P-2, Tomb of Orcus, see pl. 248 in Giglioli (1935); M-55, Cist in Ny Carlsberg Glyptotek, Inv. H. 241, H.I.N. 43, see Cist III, Tav. VII in Bordenache Battaglia and Emiliozzi (1979).

Representative examples of squares on bands: M-7, Bronze mirror from Populonia, see pl. 150 in M. Moretti (1970); M-67, Cist in Museé des Beaux Arts, Lyon, Inv. E-154, see Cist 26, Tav. CXXVIII in Bordenache Battaglia and Emiliozzi (1979); M-55, Cist in Ny Carlsberg Glyptotek, Inv. H. 241, H.I.N. 43, see Cist III, Tav. VII in Bordenache Battaglia and Emiliozzi (1979).

Representative example of chevrons: M-54, Cist in Berlin Charlottenburg Staatliche Museen, Antiken-Abteilung Inv. Misc. 6236, see Cist I, Tav. II in Bordenache Battaglia and Emiliozzi (1979).

Representative examples of zigzags: M-67, Cist in Museé des Beaux Arts, Lyon, Inv. E-154, see Cist 26, Tav. CXXVIII in Bordenache Battaglia and Emiliozzi (1979); M-74, Cist in Pierpont Morgan Library, New York, Inv. BL-64, see Cist 45, Tav. CLXXXVII in Bordenache Battaglia and Emiliozzi (1979).

Representative example of curling wave (on two figures): M-55, Cist in Ny Carlsberg Glyptotek, Inv. H. 241, H.I.N. 43, see Cist III, Tav. VII in Bordenache Battaglia and Emiliozzi (1979).

69. Representative examples of *X* on shoulder flaps: M-25, Statuette from Lake Falterona, now in British Museum, see pl. 105 in Goldscheider (1941); M-58, Figures forming cist handle, Museo Nazionale Etrusco di Villa Giulia, Inv. 25210, see Cist VII, Tav. XVII in Bordenache Battaglia and Emiliozzi (1979); M-61, Six warriors on lid of cist, Museo Nazionale Etrusco di Villa Giulia, Inv. 13086, see Cist X, Tav. XXVIII in Bordenache Battaglia and Emiliozzi (1979).

Chapter 3 • What Material Was Used to Make Type IV Armor?

1. Flaps standing upright before being tied down can be observed in the arming scenes on the following vases: R-26, Munich, Antikensammlungen 2307, ARV 26, 1, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 166.1, 172.1, CVA online vase #200160; R-30, Vienna, Kunsthistorisches Museum 3694, ARV 427, 3, pl. 281 in Boardman (1975), CVA online vase #205047; R-32, Munich, Antikensammlungen 2308, CVA Deutschland 12 München 4, pls. 169.1, 170.1, CVA online vase #200161; R-59, Madrid, Museo Arqueológico Nacional 11042, ARV 532, 49, CVA Espagne 2 Madrid, Museo Archeológico Nacional 2 (III.I.c), pl. 16.1a, CVA online vase #206026; R-61, Bologna, Museo Civico Archeologico, Pell. 274, CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 53.1, 55.7, CVA online vase #206069; R-63, Berlin 3233, ARV 414, 32, CVA online vase #204514; R-164, Frankfurt, Städel Institute STV9, ARV 818, 16, CVA Deutschland 30 Frankfurt am Main 2, pl. 63.4, CVA online vase #210116; R-183, Bologna, Museo Civico Archeologico PU274, ARV 793, 78, CVA Italia 5 Bologna, Museo Civico 1 (III.I.c), pl. 16.1, CVA online vase #209786. Other instances in which the shoulder flaps are depicted as springing upright when untied or cut, as a result of various circumstances, include: R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108; R-52, Vienna, Kunsthistorisches Museum 3695, ARV 429, 26, pl. 92 in Woodford (1993), CVA online vase #205070; R-127, Karlsruhe, Badisches Landesmuseum 69.35d, CVA Deutschland 60 Karlsruhe, Badisches Landesmuseum 3, pl. 34.9, CVA online vase #32519; and M-55, Cist in the Ny Carlsberg Glyptotek, Inv. H. 241, H.I.N. 43, see Cist III, Tav. VII in Bordenache Battaglia and Emiliozzi (1979).

2. Jarva (1995, 36). Other authors who accept the *spolas* as being a form of leather armor include Schwartz (2009, 70), Everson (2004, 152), and Anderson (1970, 20–28). Snodgrass (1999, 109), although he believes many of the Type IV corselets were leather, identifies the *spolas* as "a light cloth jerkin." In his study of Xenophon's army, Lee (2007, 112) takes an

original approach, interpreting *spolas* as referring to armor made out of either leather or laminated fabric. He reserves the term *thorax* for metal armor.

3. See Herodotus's (7.71) similar description of the Libyans employing animal skins as armor and fighting with crude, charred-wood spears.

4. On Pollux's reliability as a source for military terminology, see Bettalli's (2007, 145, 154) article on this topic, which argues that Pollux was particularly uninterested in military issues, thus making him a poor source upon which to base the entire spolas-as-leather-armor argument.

5. The word *spolas* is used a few more times by various lexicographers and grammarians who either repeat one of the passages discussed above or include it in lists of words. These are: Aelius Herodianus, *De prosodia catholica*, part 3, vol. 1, p. 521, line 22; and part 3, vol. 2, p. 932, line 34; Hesychius, *Lexicon*, letter sigma, entry 1542, line 1; Photius, *Lexicon*, letter sigma, p. 531, line 17; *Suda, Lexicon*, letter sigma, entry 956, lines 1–5; and letter upsilon, entry 701, line 3; *Scholia in Aristophanem, Scholia in aves (scholia vetera)*, argumentum-scholion sch av verse 933, line 1, 3; and verse 935, line 2; and verse 941, line 6; and verse 944, line 1; *Scholia in Aristophanem, Commentarium in aves (scholia vetera et recentiora Tzetzae)*, argumentum-dramatis personae-scholion sch av, verse 933a, line 1.

6. That the arrow in this passage could still penetrate deep enough to kill the man after punching through his shield and *spolas* should probably be read more as a reflection of the author's desire to emphasize the power of the arrow than as an indictment of the protective qualities of a *spolas*. Accounts of extraordinarily powerful arrows penetrating multiple layers of armor seem to be a common literary trope. See, for example, Diodorus 14.27.5-6 and 17.20.3; Arrian 2.27.2.

7. This, in fact, is how the Greek-English lexicon of Liddell and Scott defines the word *spolas*—as a "leathern garment, jerkin." They do not suggest that it might be any form of armor. The whole terminological issue is complicated by the fact that in some later periods, such as the Middle Ages, "jerkin" is indeed frequently used to denote a thick (and often hardened) leather shirt worn as a type of low-grade armor.

8. Anderson (1970, 268, n. 44) comes to a similar conclusion about the *spolas* in Aristophanes, saying that it is "apparently some sort of weather-proof garment, not a piece of armor," although he accepts its usage elsewhere as a type of armor (e.g., 22–23).

9. On leather in the ancient world generally, as well as tanning procedures, see Forbes (1966). For a detailed account of some very enlightening practical experiments replicating Bronze Age leather shields and the challenges in working with animal hides to produce rigid leather armor, see Coles (1962, especially 175–79). See also Coles (1977).

10. Jarva (1995, 33–44) has the fullest discussion of the visual evidence for Type IV armor. While he states that it might be possible to trace a meaningful change in the color of armor in black-figure representations from the mid-sixth to mid-fifth century B.C., he emphasizes that drawing firm conclusions about materials on the basis of their colors in vase paintings is highly problematic. Schwartz (2009, 70) accepts that the "relatively rare bright white" color on some vases is likely meant to indicate linen armor and that black "might indicate another choice of material," while nevertheless wisely warning that "we should be cautious in assuming a different material on such slight evidence." Gleba (2012) also acknowledges that, in Greek art, there are too many uncertainties to be able to iden-

tify materials on the basis of color, but she convincingly argues that, in Etruscan paintings, linen corselets can be identified as such at least partially on the basis of color.

11. The reconstructed yellowish color of the armor on the Aristion stele is debatable, and it is not clear whether this is meant to represent the natural color of a particular material such as linen or leather. Linen is notorious for its resistance to taking dyes well, and this is one reason why it often was used in its bleached form for clothing.

12. See, for example, the painted metal cuirasses discussed by Everson (2004, 95).

13. This, in fact, is exactly how Jarva (1995, 36–41, and fig. 15) envisions the production of most Type IV armor. He even made a reconstruction in this manner, and includes an image of it in his book. Its appearance very closely matches that of those vase-painting images with a continuous main body and *pteruges*, and only a single row of *pteruges*.

14. Among those who favor the interpretation of the linothorax as being composed of two quilted layers of linen that are stuffed with padding are Lumpkin (1975, 194) and Everson (2004, 110–14) for early versions, although Everson thinks later variants may have been unstuffed, but made of multiple stiffened layers (145–59). Snodgrass (1999, 90–91) seems to favor sewn but not stuffed armor, which would at least be consistent with the visual evidence. Connolly (1988, 58–59) describes a construct composed of laminated layers of linen. Most other scholars, however, including Schwartz (2009, 70–73), Lush (2007), Jarva (1995, 40–45), Anderson (1970, 20–28), and Gleba (2012), do not take a definite side, often simply stating that either a quilted or glued construction is possible.

15. The Aztec quilted body armor, called an *ichcahuipilli*, was made of unspun cotton stuffed between two layers of fabric and is routinely represented in surviving codices, where it has a distinctly puffy appearance. See Hassig (1988, 88).

16. In some vase paintings that show warriors dressing themselves, the interior surface of the armor is visible. These surfaces similarly show no evidence of stitching or quilting.

17. This rather obscure text advocating the salt and vinegar treatment was published in a short article by Törnkvist (1969). It is discussed by Jarva (1995, 42, 135–36) and Schwartz (2009, 70).

18. Törnkvist (1969, 82) and Jarva (1995, 135) report attempting to replicate this technique, but Törnkvist could achieve only "slightly stiffening effects," and Jarva does not mention whether treating the linen in this fashion affected its toughness.

19. Connolly (1988, 58) notes: "It was difficult to put on because of its stiffness, but once one had got used to it, it was quite comfortable and easy to move about in."

20. Certainly lamination involving thin layers of wood was commonly employed in military contexts. See, for example, Polybius's (6.23.3) description of how the Roman *scutum* was made using "layers of wood fastened together with bulls' hide glue."

21. The authors have been told of additional claims of laminated linen fragments uncovered in Greece at various archaeological sites from different time periods. Unfortunately, as these finds at present are attested only verbally or by email and have not yet been properly published, we can do no more at this stage than acknowledge that there may be more examples of such laminated linen. One seemingly reliable unpublished discovery of linen armor that we have heard about is a number of fragments from Masada, which are described in a forthcoming article by Hero Granger-Taylor. Details of these finds were unfortunately not made available to us at the time of writing.

22. Prof. Cohen's research into the construction and use of laminated linen theater masks has not yet been published, but she has presented papers on it at the 2008 and 2009 annual meetings of the American Philological Association and has generously shared her ongoing work with us. She and her students have reconstructed and used these masks in multiple productions of Greek plays, giving them considerable insight into how they might have functioned and been made. In the *Suda*, during a discussion of the theatrical innovations of Thespis, there is a line that says: ". . . and after that he introduced the use of masks made solely from linen" (*Suda*, theta 282, καὶ μετὰ ταῦτα εἰσήνεγκε καὶ τὴν τῶν προσωπείων χρῆσιν ἐν μόνῃ ὀθόνῃ κατασκευάσας).

23. Borza (1987, 112).

24. It is possible that, in at least some cases, these scales were made out of materials other than metal. They could, for example, have been hardened leather or some kind of lacquered construction. Whatever their exact composition, as discussed in the preceding chapter, the intent of attaching these scales could have been to offer an additional degree of protection, to serve as decorative elements, or to display the wealth or status of the owner. Also as previously noted, scales are far more common on Etruscan Type IV armor, where they occur on 34% of all examples. In Greek images, scales are present 18% of the time.

25. The Korybantes hoplite reenactors favor the unstuffed, sewn approach rather than laminating the layers. One major reason for this is that they add metal scales to nearly all of their corselets, and it is much easier to attach these to fabric that has not been stiffened with glue. This experience might suggest that images depicting Type IV armor with scales could predominantly represent a sewn construction, whereas those without scales might depict laminated versions.

26. This theory seems to have first been proposed by Sekunda (2000).

27. See Andronikos (1984, 140–44), Everson (2004, 191–93), and Connolly (1998, 58).

28. For this interpretation, see, for example, Lush (2007, 25) and Everson (2004, 193).

Chapter 4 • Reconstructing the Linothorax

1. For those interested in reconstructions employing scales, the best modern versions are probably made by Dimitrios Katsikis, who specializes in these. See his Web site (http://www.hellenicarmors.gr/) for examples. Such scales add greatly to the weight of the final corselet. A corselet that he made based on the famous vase painting of Achilles wearing a Type IV linothorax that is entirely covered in scales (fig. 2.8) required 1,300 scales and increased the weight of the armor from 4 kg to 14 kg. This particular reconstruction can be viewed at http://www.hellenicarmors.gr/products.php?pageId=15.

2. Six of these were published by Postolacca (1868, nos. 742–47; database M-33 to M-38), three by Crosby (1964, nos. L 227–L 229; database M-39 to M-41), and the last two were part of a 1971 find published by Kroll (1977b, nos. 2 and 3; database M-42 to M-43). On the identification of the 1971 find as a deposit of records relating to the third-century B.C. Athenian cavalry, see Kroll (1977a).

3. On the state maintaining stores of arms and armor that were sometimes issued to militia, see the examples collected by Pritchett (1971, 3–4).

4. This interpretation, as well as the most accessible discussion of these tokens and illustrations of tokens bearing corselets, helmets, greaves, and shields, can be found in Kroll (1977b).

5. We caution anyone who wishes to construct his or her own linothorax out of historically accurate materials to be extremely skeptical regarding the claims to authenticity made by many vendors of linen, especially over the Internet. Even when the linen obtained from such sources is handspun and handwoven, it has often been made from flax plants that have been mechanically harvested and processed with modern chemicals, which results in a product very different from that obtained using ancient methods. We suggest contacting local traditional weavers, many of whom grow and process their own plants.

6. Plain, or tabby, weave is the most basic of weaving patterns, in which each thread of the weft alternately goes over a warp thread and then under the next one in a repeating sequence.

7. As an example, the recent discovery of a first-century B.C. Roman helmet in a riverbed near Xanten, Germany, whose decorative metal parts remained attached with an adhesive after 2,000 years of immersion, produced a plethora of news articles about Roman "superglue" (see, e.g., http://dsc.discovery.com/news/2007/12/14/romans-glue-helmet.html). Upon analysis, this glue was found to contain bitumen, bark pitch, and animal grease, but the researchers were unable to duplicate it, probably because the original contained yet other elements whose identity could not be determined.

8. In personal correspondence with Aliades Antonis of the reenactor group Korybantes, he reported similar tribulations using glues derived from ancient recipes. In his case, a linothorax that had been constructed with fish glue was partially eaten by insects while in storage.

9. "Slab" might seem an odd choice of terminology for these pieces of layered cloth, but it really does capture something essential about the heft and feel of them during construction.

10. For a more comprehensive discussion of different styles of *pteruges*, see the preceding chapter on structural variants and decoration.

11. The flexibility of the *pteruges* can be witnessed, for example, on the Alexander Mosaic, where one of the flaps on his right hip is curling upward without any external force being applied other than the forward momentum of his charge (plate 2).

12. Because of this continuity, it has been argued, for example by Jarva (1995), that the material of the armor must have been leather. While this may be the case, it would certainly also be possible to cut the flaps out of a laminated linen slab using a saw to make the incisions.

13. For discussions of potential different structural arrangements of the *pteruges*, see Schwartz (2009, 72), Everson (2004, 142–58, 187–94), and Jarva (1995, 33–35, 40–43).

14. R-182, Athenian red-figure amphora (Type B), the Achilles Painter (name vase), Vulci, c. 460-40 B.C., Vatican City, Museo Gregoriano Etrusco Vaticano 16571, ARV 987, 1, pl. 109 in Boardman (1989), CVA online vase #213821.

15. This debate hinges on another controversial issue: How did hoplites hold their spears in battle? The standard view, supported by literary accounts and vase paintings, is

that, when massed in the phalanx and entering battle, hoplites held their spears at shoulder level. Such a posture would be incompatible with underhanded thrusts to the lower belly and groin. There are a few vase paintings that show warriors aiming underhanded thrusts of their spears at their opponents' groins, but these are always one-on-one duels rather than phalanx battles, and presumably in such situations, there would have been greater latitude in tactics. A good discussion of this issue, with references to the relevant texts and images, is offered by Lazenby (1991, 92–97).

16. This same observation about heroic nudity is made by Jarva (1995, 34) when discussing these images. On this subject, and with further visual examples, see Anderson (1970, 21–25, and n. 39 and n. 59 on 268 and 270–71). Anderson makes the useful suggestion that the way in which we interpret some of the images of armed yet naked Greek warriors should be informed by the context of Greek athletics. In these contests, nudity certainly played an important cultural role, and there were events, such as the hoplite run, in which athletes perhaps did display such an odd combination of armor and nudity.

17. On the depiction of nudity in Greek art and its symbolism, see the insightful article by Bonfante (1989), with extensive further bibliography.

18. The Parthenon figures (database S-13) include ones on the North Frieze, slabs 12 and 38; the South Frieze, slab 13; and the West Frieze, slab 6. For additional examples of horseback images, see the discussion and accompanying notes on cavalry use of the linothorax in chapter 7.

19. In our first reconstruction, these metal rings are held in the mouths of small brass lions' heads (see plate 6). The flat back of each lion's head is attached firmly to the laminated slab by metal posts that pierce the slab. These lion heads with rings in their mouths are almost identical in size and form to fastenings found on the famous iron cuirass from the so-called tomb of Philip II at Vergina. We did not need to have ours custom-made; they were a fortuitous off-the-shelf discovery in a hardware store, where they were being sold as drawer pulls.

20. R-28, Paris, Cabinet des Médailles 863, ARV 187, 53, CVA online vase #201705.

Chapter 5 • Arrow Test Methodology and Materials

1. The literature on hoplites and their equipment is extensive, but excellent starting points include Krentz (2010), Schwartz (2009), Sabin, van Wees, and Whitby (2007), Lee (2007), van Wees (2004), Everson (2004), Snodgrass (1999), Jarva (1995), Hanson (1989, 1991), Connolly (1988), Pritchett (1971, 1975, 1979, 1985, 1991), and Anderson (1970).

2. We have occasionally encountered objections to this assumption by those who maintain that nearly all ancient combat archery would have been from extremely close ranges in which the arrows would follow a flat trajectory. Certainly there would have been situations in which such point-blank arrow fire took place, but it seems illogical to bother bringing a long-range projectile weapon to a battle and then not employ it for the majority of its range. Low-velocity projectiles such as arrows, especially the heavier sorts appropriate for use in combat, lose altitude quickly due to gravity, so that any archer aiming at a target further away than about a dozen meters is already going to have to allow for a certain amount of drop in the flight of the arrow when he releases it. In other words, one is almost

always aiming at a point higher than the target that one wishes to hit. (On the ballistic qualities of arrows, see Denny 2003, 2007, 2011.) Almost no arrow shots would ever truly follow a "flat trajectory" but rather would always be following an arc through the air, and thus they almost all constitute, to a greater or lesser degree, "lofted" or "indirect" shots. The angle at which one aims upward increases to 45 deg., at which point the maximum range of the bow is reached. From the perspective of a person at the receiving end of arrow fire, most arrows would be descending in an arc toward you at an angle of between 0 and 45 deg.

Occasionally, arrows may have been lofted at their targets at a more extreme upward angle so that they descended at a sharper angle of 45–90 deg. Such shots would reduce the maximum range of the bowshot but could have been used to fire at troops hiding behind an obstacle, such as a wall, or perhaps to hit soldiers, such as hoplites, who were protected from more horizontal missile attacks by a wall formed of their shields. This seems to have been the situation at the Battle of Thermopylae, which led to the famous comment by the Spartan Dienekes—that they would "fight in the shade" because the arrows of the Persians would block the sun (Herodotus 7.226). Especially if the hoplites in a phalanx were equipped with shield aprons, which hung from the bottom edge of their shields and protected their legs from missile fire, such a high-angle attack would have been the only way to get at the men protected behind the barrier posed by shields and aprons.

3. On the role of peltasts and other light infantry, see Best (1969) and Griffith (1981), as well as the sources listed in note 1 on hoplites. See particularly the comments of Anderson (1970) on their effectiveness.

4. A nice illustration of the effective use of highly mobile skirmishers against hoplites is Xenophon's account of how a group of Corinthian peltasts armed with javelins was able to whittle down and eventually wipe out a group of several hundred Spartan hoplites at Lechaion. The peltasts employed classic skirmisher tactics, individually running toward the massed Spartans and flinging their javelins into them. The Spartans attempted to counter by chasing after the peltasts but, burdened by their heavier arms and armor, were unable to catch any of them (*Hellenica* 4.5.11-17). Even throwing their javelins at a 45-deg. angle for maximum range (as is routinely depicted in vase paintings of athletes), these peltasts would have had to come dangerously near to the Spartans, as the combat range of an ancient javelin seems to have been fairly short, probably no more than 50–60 m. At these close distances, the peltasts needed to have considerably lighter equipment in order to be able to evade the lunges of the angry hoplites.

On Greek javelin throwing and its range, in sports and combat, see Harris (1963). As well as analyzing textual and visual evidence for javelin throwing, Harris engages in some reconstructive archaeology attempting to determine the proper usage of the thong or strap attached to ancient javelins.

5. On the Macedonian phalanx and especially its armor, see Lush (2007). Also useful are Chaniotis (2005), Snodgrass (1999), Connolly (1988, 2000), Adcock (1957), Griffith (1956–57), and Markle (1977, 1978, 1982).

6. Specifically on the *sarissa*, its dimensions, and its use, see Sekunda (2001), Connolly (2000), Manti (1994), Hammond (1980), Markle (1977), and Andronikos (1970).

7. We used several sources for our more authentic linens, but one of the most copious suppliers of this fabric was master traditional weaver Sarah von Tresckow, who operates the

store Woolgatherers Ltd. in Fond du Lac, Wisconsin (www.woolgatherers.com), and who also provided much useful practical advice about weaving.

8. See Erdmann (1973, 35, 45, and 49) for illustrations of her typology of arrowhead types. On arrow and arrowhead types, see also Blyth (1977, 31–64, 206–17).

9. Truly exact statistics on ancient arrowheads in terms of their weight, shape, and metallurgical composition are not readily available in scholarly publications. We had to base our replicas on information gleaned from the sources listed in the previous note, and upon our own visual examination of the shapes and characteristics of available arrowheads on display in various museums. While the lack of more precise specifications for ancient arrowheads is not an ideal situation from a scientific viewpoint, it was one of the motivations that led us to employ a wide range of arrowhead shapes, weights, and metals, so as to cover a reasonable range of possibilities. For a study of the penetrating power of arrowheads that does take into account the metallurgical characteristics of the arrowheads (although in this case, medieval ones), see Jones (1992).

10. McLeod (1965) helpfully assembles and fully quotes the various literary citations regarding the range of ancient bowshots. His article also constitutes a thorough review of the relevant scholarly literature up to that date.

While such shots as that of Anaxagoras are sometimes applied to discussions of ancient warfare, this represents a misunderstanding of ballistics and the requirements of arrows intended for war versus distance. Arrows intended to travel long distances are specialized in construction and tend to be extremely light. Because Anaxagoras was shooting in a competition for distance, he must have been using such a specialized light arrow in order to achieve that sort of range. These arrows would be highly ineffective in a military context because they would lack the mass to penetrate their target. The modern record for archery distance using advanced bow and arrow technology optimized for range is around 1,200 m (Denny 2011, 98).

11. Zutterman (2003) offers an excellent discussion of the various types of bows employed in the ancient Near East. This article contains copious illustrations that make clear the distinctions among these various bows, as well as among the basic bow types such as curved, recurved, and composite. See also Blyth (1977).

12. For the ancient testimony on ranges, see McLeod (1965); for the mathematical calculations, see Denny (2003, 2011); for experiments with reconstructive archery, particularly focused on medieval longbows, which were more powerful than the bows that we are dealing with, see Williams (2003), Hardy (1993), Bradbury (1992), Bergman and McEwen (1988), Blyth (1977), and Pope (1962).

13. It is important to keep in mind that while an archer might not have been able to penetrate an opponent's armor until uncomfortably close point-blank ranges, there were good reasons for shooting arrows from much longer distances. One could always hope to get lucky and have an arrow strike an unprotected patch of skin, for example, at the neck or through an eye slit. Arrows that struck unarmored arms or legs might not kill a warrior, but they could well disable him. Finally, the psychological harassment of having to advance through a rain of arrows could have had a negative effect on morale and on the cohesion of a formation of men.

14. When using any traditional type of bow, whether straight, reflex, or composite, the draw weight steadily increases as the bowstring is pulled back. At maximum draw length,

the draw weight logically is also at a maximum. With modern compound bows, however, the draw weight increases as the bowstring is pulled back, but the bows are designed so that when the maximum draw length is reached, the tension on the string drops to the holding weight. The holding weight is often about a third less than the maximum draw weight. Being able to keep the bow drawn at the holding weight is a great advantage for aiming, particularly when one is hunting and waiting for the ideal moment to shoot. When the string is released, the full draw weight is applied.

15. On ancient Greek and Near Eastern bows generally, see Zutterman (2003), Winter (1990), Blyth (1977), and McLeod (1965). On the specific controversy regarding the use of bows at the Battle of Marathon, see Krentz (2010), Donlan and Thompson (1976, 1979), McLeod (1970), and Hammond (1968).

16. One of the most scientific efforts to measure the penetrating ability of ancient arrows is the unpublished Ph.D. thesis by Blyth (1977), which sought to assess the protective capacity of Greek armor against arrows during the Persian Wars. Blyth's experiments, which were performed using scientific methodology, provide useful comparative data. Similarly, Gabriel and Metz (1991) include an ambitious attempt to analyze the effectiveness of a wide array of weapons and armor employed in the ancient world by civilizations ranging from the Sumerians through the Romans. While the authors appear to have carried out elaborate tests, at times, not enough specific details of the materials and methods used in their experiments are given to be able to evaluate their validity or to allow direct comparison with our results.

There have also been serious efforts to measure the power of medieval arrows, especially those shot from English longbows. Not only do these studies provide interesting comparative data, but some of them attempt to estimate performance information for ancient bows and armor as well. Among the best of these studies are: Williams (2003), a carefully done metallurgical analysis of medieval armor, which concludes with some tests of the armor against various weapons, including arrows (918–44); Jones (1992); Bergman and McEwen (1988); and Pope (1962), all of which describe various experiments trying to measure the power of arrows shot by English longbows. Finally, an article by Blyth and Atkins (2002) contains an enlightening scientific analysis of the force required to penetrate armor plates. See also Blyth (1993).

17. The flight of an arrow is quite complicated to model in mathematical terms and is influenced by important factors beyond just the weight of the arrow, the power of the bow, and the angle of its initial trajectory. The force of aerodynamic drag works against projectile velocity, while aerodynamic lift works perpendicular to projectile velocity. Subtle qualities of the bow itself, such as string mass and elasticity, can have pronounced effects. Finally, environmental factors such as wind can also substantially affect the flight of the arrow.

We have tried to keep this text largely free of the elaborate mathematical calculations involved in measuring and describing the flight of arrows. For those interested in these details but without advanced knowledge of ballistics, two handy books written by a physicist but aimed at a general audience, which fully explain the various forces and formulas involved in calculating the flight of arrows and other projectiles, are Denny (2007, 2011). See also his 2003 article in the *European Journal of Physics*.

Chapter 6 • Arrow Test Results

1. The details of the energy calculation for this shot are ½ × [.034 kg (mass of arrow) + .013 kg (mass of arrowhead)] × 42 m/sec × 42 m/sec = 41.5 J.

2. For example, a shot that fell just barely short of the fatal depth (which therefore gives a good indication of the minimum threshold for this number) was fired at the authentic patch from the 45-lb. bow at a distance of 7.5 m using the small, iron, leaf-shaped arrowhead. The weight of this arrow plus its arrowhead was 47 g, and the measured velocity of this shot was 54 m/sec. Thus the estimated kinetic energy was ½ × .047 kg × 54 m/sec × 54 m/sec = 68.5 J.

3. For example, at the point-blank range of 7.5 m, most arrows shot from the relatively powerful 60-lb. bow penetrated deeply enough to have at least the potential to inflict fatal injury, but at any greater distance, they did not. This is likely a stronger bow, however, than most of those used during the era when the linothorax seems to have been most widely employed.

4. A video that includes one of these shots can be viewed at: http://www.uwgb.edu/aldreteg/Linothorax.html. Similar shots are featured in the documentary shows *Penn and Teller Tell a Lie*, episode 6, and *Museum Secrets: Athens National Museum*.

5. Throughout this section, we use the term "authentic" (in quotes) as shorthand to denote the handspun, handwoven linen made from plants that had been processed by hand using traditional methods. We are aware that this fabric is not truly authentic in the sense of being exactly the same as that produced in the ancient world but rather is a modern approximation.

6. Many authors (such as Blyth, 1977, 39–40) believe that ancient cast bronze (and perhaps iron) arrowheads were often not given any additional sharpening by being rubbed against a file or hard surface but rather were used in the state in which they were produced. Because we wanted to subject our armor to the strictest worst-case scenario test, we employed a metal file to sharpen all arrowheads before use. We also repeated this sharpening after every few shots in order to keep this variable relatively constant.

7. The weights of some of our replica arrowheads are quite heavy by modern archery standards, where hunting points are usually no more than around 125 grains. Unfortunately, the weights of extant ancient arrowheads are often not reported in archaeological publications, and when they are, they seem to cover a wide range, from as light as modern arrowheads to some that are even heavier than our heaviest replica. Because of this wide variation in attested ancient arrowheads, we chose a similarly broad range of shapes and weights for our tests. In order to withstand the stresses of being fired from our 60-lb. pull bow, our wooden arrows were thicker than many modern arrows, which are made out of sturdier metal or composite materials. Any ancient arrows shot from ancient bows of similar strength would by necessity have had similar diameters.

8. Anderson (1970, 24–28) has an excellent discussion, based on close examination of the visual evidence, of the various types of garments that Greek warriors wore beneath their armor.

9. Bleetman and Dyer (2000, fig. 1, 610). For a detailed description of the biomechanics involved in stab attacks, see Chadwick et al. (1999).

10. One possible caveat to be considered when applying this study to the ancient world is that it did not measure penetration depth to the stomach and bowel because the mobility and range of distension for these organs is so great that the data would have been highly inconsistent. While the depth of penetration required to perforate these organs would be similar to those measured in the study owing to the basic thickness of the overall skin and musculature, this does raise the possibility that, under just the right circumstances, a lucky shallower penetration of perhaps as little as 10 mm might be sufficient to result in an injury that would eventually prove fatal.

11. Pausanias 1.21.5-7: "[5] For the Sauromatae have no iron, neither mined by themselves nor yet imported. . . . To meet this deficiency they have contrived inventions. . . . [6] Their breastplates they make in the following fashion. Each man keeps many mares. . . . Their hooves they collect, clean, split, and make from them as it were python scales. Whoever has never seen a python must at least have seen a pinecone still green. He will not be mistaken if he likens the product from the hoof to the segments that are seen on the pinecone. These pieces they bore and stitch together with the sinews of horses and oxen and then use them as breastplates that are as handsome and strong as those of the Greeks. For they can withstand blows of missiles and those struck in close combat. [7] Linen breastplates are not so useful to fighters, for they let the iron pass through, if the blow be a violent one. They aid hunters, however, for the teeth of lions or leopards break off in them. You may see linen breastplates dedicated in other sanctuaries, notably that at Gryneion." The Greek for section 7 is: οἱ δὲ θώρακες οἱ λινοῖ μαχομένοις μὲν οὐχ ὁμοίως εἰσὶ χρήσιμοι, διιᾶσι γαρ καὶ βιαζόμενοι τὸν σίδηρον θηρεύοντας δὲ ὠφελοῦσιν, ἐναποκλῶνται γάρ σφισι καὶ λεόντων ὀδοντες καὶ παρδάλεων. Θώρακας δὲ λινοῦς ἰδεῖν ἔν τε ἄλλοις ἱεροῖς ἔστιν ἀνακειμένους καὶ ἐν Γρυωείῳ.

12. Tacitus's version differs slightly in that it does not say that Galba volunteered his neck but simply states that a soldier pierced his throat while others "mutilated his arms and legs because his chest was protected"— a description that again emphasizes that his body armor apparently offered him excellent protection (*Histories* 1.41).

13. For example, our replica Roman *gladius* and Greek *kopis* were defeated by the test patch, but a long, narrow Viking blade was more successful. Similarly, our replica broad-headed hoplite spear was not that effective in penetrating the armor, but a spear with a *pilum*-like point performed better.

14. In a few places in the tables, usually involving the BSLP and BSBP bronze arrowheads, the data sets are not complete. This is due either to all of our stock of these types of arrowheads being lost because of poorly aimed stray shots or to all of the arrowheads of the type breaking before the full set of data could be obtained. In all of these cases, however, the overall pattern of the data is clear enough.

15. On this issue, see Jarva (1995, 132–35), Blyth (1977, 65–85), and Courbin (1957, 340).

16. On helmets, see Blyth (1993; 1977, 67–84).

17. The helmets studied by Blyth (1993) had a tin content of 8%, those analyzed by Craddock (1975) had a tin content of between 7.1% and 11.8%, and the sixth-century B.C. Cretan armor tested by Smith (1900) varied between 9.5% and 11%.

18. Our bronze plates were supplied by a local artist who works in metals. We were not able to obtain as authentic a sample of bronze plates as we might have preferred. Our

plates were annealed bronze with a content of approximately 86% copper, 11% tin, and 2% lead.

19. The details of the physics involved in perforation of metal plates by edge weapons are more complex than has been summarized here. Fortunately, scientific studies have been done on this topic that have carefully analyzed and measured all the processes involved, including deformation, crack initiation, fracture, tensile stretching, petal formation and roll up, and friction. See Williams (2003, 918ff.), Blyth and Atkins (2002), Wierzbicki and Thomas (1993), and Blyth (1977).

20. The 72 J estimate represents an average for the various arrowheads. For example, here is the energy calculation for the small, iron leaf point: The projectile mass is .047 kg, which is the sum of .034 kg (the arrow) plus .013 kg (the arrowhead), and the average of the measured velocities of this arrowhead shot from the 60-lb. bow is 55 m/sec. The energy equation is thus: $\frac{1}{2} \times .047\,\text{kg} \times 55\,\text{m/sec} \times 55\,\text{m/sec} = 71\,\text{J}$.

21. The 20-layer 11.5-mm-thick laminated fabric test patch measured approximately 45 cm by 45 cm and weighed 1.04 kg. The bronze 1.8-mm plate of the same dimensions weighed 2.49 kg.

Chapter 7 • Wearability Issues

1. See, for example, the comments of Pliny, *Natural History* 19.1–2.

2. One of the authors was unexpectedly caught in a brief but torrential downpour while outdoors wearing one of the reconstructions that had been made with highly water-soluble PVA glue, and it survived without any damage.

3. Examples of bridge building to cross rivers include spanning the Euphrates (Arrian, *Anabasis* 3.7) and the Indus (Arrian, *Anabasis* 5.7–8).

4. Skins or stuffed tents were also used to cross the Oxus (Arrian, *Anabasis* 3.29) and the Hydaspes (Arrian, *Anabasis* 5.9).

5. On Greek naval warfare and the number of troops carried aboard warships, see Strauss (2007), van Wees (2004), and Morrison, Coates, and Rankov (2000). On Hellenistic naval matters, see de Souza (2007), Gabrielson (1997), and Morrison and Coates (1996). On the Persian navy, see Wallinga (1993).

6. Persians, in 480 B.C., Herodotus 7.184; Chians, in 494 B.C., Herodotus 6.15; Corinthians, 27 hoplites, in 435 B.C., Thucydides 1.29, and 38 hoplites, in 431 B.C., Thucydides 2.33.1. In specialized circumstances, such as when warships were being used as transports to carry an invasion force, the numbers could have been much greater. See van Wees (2004, 311–12, nn. 20 and 21).

7. In light of the sweet honey-like smell imparted by the beeswax waterproofing, one is tempted to suggest a practical explanation for the otherwise mysterious insistence of Plutarch that Alexander's skin emitted a sweet smell. Plutarch claims that this "very pleasant odor" of his skin "permeated all his garments with its fragrance." Perhaps it was the other way around? (Plutarch, *Alexander* 4.2).

8. On repair of arms and armor in the field, see Croom (2000) and Lee (2007, 127–32). On rust and ancient military equipment, see Croom (2000) and Leslie and Croom (1996).

9. The cist is in the Ny Carlsberg Glyptotek, Copenhagen, Inv. H 241, H.I.N. 43 (database M-55). A photo and line drawing of the lid can be found in Bordenache Battaglia and Emiliozzi (1979), Tav. VII, IIIe and IIIf, cist III.

Another instance of a shoulder flap springing upright, although in this case after being untied deliberately, occurs on the famous vase painting of Achilles bandaging a wounded Patroklos (fig. 2.8). One shoulder flap, which has been untied for access to the wound, is shown jutting vertically upright with the laces flapping free. (See database R-43, Berlin, Antikensammlung F2278, ARV 21, 1, pl. 23 in Woodford (1993), CVA online vase #200108.) Both of these examples once again illustrate that the material from which the depicted armor was made had to possess a natural stiffness and resiliency that caused the flaps to spring upright when not held down. Such a degree of stiffness and springiness would be unlikely to be found either in layers of cloth that were merely sewn together or in a sheet of leather.

10. Leather armor would also suffer abrasion, although perhaps to a slightly lesser extent.

11. Some of the 42 examples of cavalrymen wearing Type IV armor in the visual database are: R-72, Orvieto, Faina Collection no. 48, in Sekunda (2002, 51); R-149, London, British Museum 99.7-21.5, ARV 1052, 29, CVA Great Britain 8 London, British Museum 6 (III.I.c), pl. 103.1b, CVA online vase #213658; R-159, Berlin, Antikensammlung 4982.19, ARV 860, 5, CVA Deutschland 22 Berlin, Antiquarium 3, pls. 104.1–4, 131.3, CVA online vase #211328; R-165, Naples, Museo Archeologico Nazionale H2421, ARV 600, 13, CVA online vase #206941; R-175, Agrigento, Museo Archeologico Regionale 2688, ARV 599, 2, pls. 176, 178, 179, 181 in Arias (1962), CVA online vase #206930; R-190, Geneva, Musée d'Art et d'Histoire MF238, ARV 615, 1, CVA Suisse 1 Genève, Musée d'Art et d'Histoire 1 (III.I), pls. 14.1–4, 16.1–3, CVA online vase #207115; R-206, Paris, Musée du Louvre G414, ARV 1051, 11, CVA France 4 Paris, Musée du Louvre 3, pl. 19.2, CVA online vase #213642; R-218, Bologna, Museo Civico Archeologico 289, ARV 891, Bologna 289, CVA Italia 27 Bologna, Museo Civico 4 (III. I), pls. 73.3–4, 74.7–8, CVA online vase #211752; R-226, London, British Museum 98.7-15.1, ARV 1048, 35, CVA Great Britain 4 London, British Museum 3 (III.I.c), pl. 25.1e, CVA online vase #213604; R-228, Boston, Museum of Fine Arts 95.48, ARV 1248, 2, pl. 230 in Boardman (1989), CVA online vase #216938; R-232, Lecce, Museo Provinciale Sigismondo Castromediano 574, CVA Italia 4 Lecce, Museo Provinciale 1 (IV.Dr.), pl. 4.3, CVA online vase #9002209; R-235, Policoro, Museo Nazionale della Siritide 35304, pl. 25.3 in Trendall (1967); S-13, Parthenon, north frieze slabs 12 and 38, south frieze slab 13, west frieze slab 6; S-21, Relief of warrior on horseback from Pelinna, Thessaly, now at the Louvre; S-30, Funerary stele of Nikanor, Kilkis Archaeological Museum 2315; T-1, Etruscan terracotta gable relief, Arezzo, Piazza S. Jacopo, pl. 136 in Sprenger and Bartoloni (1977); T-2, Archaic terracotta relief, Florence, Museo Archeologico, no. 4932, pl. 160, no. 551 in Andrén (1939); M-11, Handle of gold comb from Solocha, St. Petersburg, Hermitage Museum, pl. 161 in Boardman (1985); M-79, Bronze equestrian statue of Alexander the Great, Naples, Museo Archeologico Nazionale 4996; P-10, Alexander Mosaic, Naples, Museo Archeologico Nazionale.

12. R-159, Berlin, Antikensammlung 4982.19, ARV 860, 5, CVA Deutschland 22 Berlin, Antiquarium 3, pls. 104.1–4, 131.3, CVA online vase #211328.

13. For cavalry, see the preceding notes. For heavy infantry, see the hundreds of vase depictions of hoplites. For light troops, see the vase depictions of Persian infantry, such as R-144, Berlin, Antikensammlung F2331, ARV 646, 7, pl. 360 in Boardman (1975), CVA online vase #207519; and R-176, Basel, Antikenmuseum und Sammlung Ludwig BS480, CVA Schweiz 7 Basel, Antikenmuseum Basel und Sammlung Ludwig 3 (III.I), pls. 8.3–4, 9.3–4, CVA online vase #1287. For marines, see Herodotus 7.89.

14. Frontinus, *Stratagems* 4.1.6. In contrast, the previous number of servants required by hoplite-style soldiers may have been anywhere from one to as many as seven per soldier. For single servant: Herodotus 7.229; cf. Thucydides 3.17.4; for seven servants, see Herodotus 9.10 and 9.29. Many Greek hoplites seem to have been accompanied by an entourage of slaves, retainers, baggage carriers, and shield-bearers.

On flocks of servants carrying arms and armor and accompanying hoplites, see the discussions by van Wees (2001; 2004, 68–71), Hanson (1989, 61–63), and Pritchett (1971, 49–51). They cite numerous ancient texts that give the impression that hoplites would not don their heavy armor until the last possible moment before going into battle. See also Welwei, who examines specifically the role of slaves in Greek warfare in Athens and Sparta (1974), and in other states and during the Hellenistic era (1977).

15. R-52, Vienna, Kunsthistorisches Museum 3695 (formerly Österreichisches Museum 325), ARV 429, 26, CVA Österreich 1 Wien, Kunsthistorisches Museum 1 (III.I), pls. 11.1–2, 12.1, CVA online vase #205070; R-152, Palermo, Mormino Collection V676, ARV 641, 83, CVA Italia 14 Palermo, Museo Nazionale 1 (III.I.c), pl. 21.6, CVA online vase #207435.

16. R-68, Universität Zürich, Archäologische Sammlung L5, ARV 1656, 2 bis, CVA online vase #275252; R-81, Vatican City, Museo Gregoriano Etrusco Vaticano 16583, ARV 373, 48, fig. 12 in Jarva (1995), CVA online vase #203946.

17. Hanson (1989, 56) conducted experiments with students dressed in replica full hoplite panoplies weighing close to 32 kg, with the result that the students became "utterly exhausted" after only 30 minutes mock-dueling in the hot sun. More recent scholarship has argued that the bronze cuirasses worn by hoplites may have been significantly lighter than originally thought (see Krentz 2010, 46), but even these lighter breastplates would have the same heat-intensifying effects in direct sunlight.

18. Schwartz (2009, 98–101) has a useful summary of the evidence for the likely physiology of ancient Greek warriors, including references to studies that attempt to determine average heights and weights.

19. Connolly's (1988, 58) reconstruction of a laminated linen linothorax weighed 3.6 kg, Jarva's (1995, 135) estimate for an 18-layer linen corselet is 4 kg, and hoplite reenactors who have made their own linothorakes report similar weights of 3.5-4 kg.

One factor that could have substantially increased the weight of Type IV armor (whether made of linen or leather) was if metal scales were added to the exterior. Although such additions appear on less than 18% of Greek vase paintings, this nevertheless constitutes a significant minority. Depending on how much of the armor possessed such an overlay, and the thickness of the scales themselves, such augmentations could easily have multiplied the total weight of the armor several times over. Jarva (1995, 136) offers an estimate of 16 kg based on scales 0.5 mm thick and 2.5 by 4.2 cm in size. Even placing a basic band of scales just around the abdominal region could have doubled the armor's weight.

Dimitrios Katsikis, the armorer of the reenactor group Korybantes, has made Type IV corselets with both added scales and metal plates. The scales he used vary between 0.4 and 0.8 mm in thickness, and the plates from 1.2 to 1.5 mm. He has crafted versions that use only small patches of scales in certain spots, such as over the belly, all the way up to ones that have scales covering every surface, including the *pteruges*. Even a band of scales around the stomach typically doubles the weight from 4 to 7 or 8 kg, and his reconstruction totally covered in scales weighed a hefty 14 kg and employed 1,300 individual scales. Images of these can be viewed at the Web sites http://www.hellenicarmors.gr/ and http://www.koryvantes.org/koryvantes/index.jsp.

20. See, for example, a partial early cuirass from a grave in Argos that weighed 3.4 kg (Courbin 1957, 340) and two fourth-century B.C. cuirasses from Italy weighing 3.8 and 3.4 kg (Cahn 1989, 58–60, 66).

21. See the discussion of this anecdote by Jarva (1995, 135), who offers the conversion figures.

22. Hanson seems to have based his calculations on those of Donlan and Thompson (1976, 341).

23. Connolly (1988, 58), Jarva (1995, 135). See also the discussion of weight in Schwartz (2009, 95–98).

24. Some thinner cuirasses plainly existed but would have offered such minimal protection as to have been little more than decorative.

25. Some of these advantages would be lost if a Type IV corselet were coated in scales. In personal correspondence, Aliades Antonis of the hoplite reenactor group Korybantes noted that when even the most physically fit of the reenactors were wearing 14- to 16-kg Type IV armor with added scales or metal plates, they could undertake heavy physical activity for no more than half an hour, but when wearing a 4-kg linen-only version, they could exercise indefinitely, even over rough terrain.

26. A good recent summary of this debate can be found in Schwartz (2009, 95–98). Some specific estimates of the typical weight of a full hoplite panoply by various scholars include: 13-22 kg, Krentz (2010, 50); 20 kg, Schwartz (2009, 96); 32 kg, Hanson (1989, 56); 26 kg, Rüstow and Köchly (1852, 11–20); 33 kg, Fuller (1946, 37); 20–30 kg, Jarva (1995, 138); 23 kg, Lee (2007, 116).

27. The bibliography on Marathon (and specifically on the credibility of the Athenian running charge) is extensive, but some key works on these topics include Krentz (2010), Storch (2001), Donlan and Thompson (1976, 1979), Hammond (1968), How (1919), and Delbrück (1887, 1900). On archery and hoplites, see McLeod (1965, 1970), Winter (1990), Zutterman (2003), and Blyth (1977).

28. The classic studies of the practicality of running a mile in hoplite panoply are Donlan and Thompson (1976, 1979). They conducted experiments with college students carrying simulated hoplite gear running across uneven ground and on treadmills and concluded that it would have been impossible for all but a tiny percentage of exceptionally fit individuals to run such a distance and then engage in battle. Many have accepted their conclusions as proving that Herodotus's account is an exaggeration and that the Athenians at Marathon either did not run as fast or as far as he claims. Other scholars have disputed this, however. For a lengthy recent refutation of Donlan and Thompson, see Krentz (2010, 142–52).

We, too, believe that there is some element of exaggeration in Herodotus, and that early estimates for the weight of a hoplite panoply were too high. In addition, one methodological aspect of Donlan and Thompson's (1976, 340) studies that may be flawed is that they had their test subjects run with the simulated heavy 9-lb. shields held "extended on the left arm and the subjects were instructed to hold them chest high." Presumably this was done either because this was the position the shield would need to be in for fighting once they reached the Persians, or because this posture was thought necessary to offer protection from incoming arrows. Both are faulty assumptions. There was no practical need for the hoplites to have their shields in combat position until just before contact with the Persian ranks. Arrows would not have been a serious danger until the last 50 yd. or so, and prior to this range, arrows would likely have been arriving at an angle from above, rather than from the front; thus the frontally positioned shield would not have offered good protection against this threat anyway.

The posture forced on the test subjects is an extraordinarily unnatural and awkward one for holding a heavy object while running, and, not surprisingly, it was this demand that greatly contributed to the fatigue of the subjects and hence the authors' conclusions about the improbability of Herodotus's account. On the other hand, if the Athenians (and the test subjects) held their arms in a more relaxed position, with the shield hanging from a bent arm on the left side of the body in the natural posture people adopt when running, then they might have been able to sustain a high-speed run, or at least a speedy trot, for a much greater distance. They then could have covered the majority of the distance running more easily and would only have switched to the shield-frontal combat posture for their final approach. In our field experiments, a fit individual wearing a linothorax and holding a shield by his side was able to run close to full-speed in hot weather for sustained periods of time.

Focusing on the fact that the sources do not mention Persian arrows playing a significant role in the battle, Storch (2001) offers the original argument that the Greeks surprised the Persians by advancing so quickly that the Persians were unable to fire their bows before the Greeks were upon them. While we would agree that Persian arrows were not an important factor in the battle, we contend that this was because the Greeks' shields, helmets, and corselets were highly effective in protecting them from Persian arrows, not because those arrows were never fired. Storch never seems to consider this possibility, and repeatedly assumes that if arrows had been shot by the Persians, they "would have done so with deadly effect," causing great "carnage" among the Greeks (388). It also stretches credibility that even a surprised archer could not have managed to get off a good number of arrows. A merely competent traditional archer can unleash an aimed shot every few seconds, and once the Greeks had approached within 100–200 m of the Persians, surely the archers would have been keeping a wary eye on them.

29. Alexander seems to have followed the precedent established by Philip of minimizing the army's baggage train by making the soldiers carry their own equipment and greatly cutting down on the number of camp followers. For ancient references and a more in-depth discussion of these topics, see the classic work by Engels (1978) on the logistics of the Macedonian army. For a summary of the arguments both for and against body armor being used by the Macedonian phalanx, see Lush (2007). For a more recent discussion of

Greek army logistics, but focusing on Xenophon's experiences, see the excellent analysis by Lee (2007).

Chapter 8 • Economic and Social Considerations

1. On the average size of ancient Greek warriors, see the discussion by Schwartz (2009, 98–101), with additional bibliography.

2. Practical details regarding processing flax and spinning and weaving linen are derived from various sources, including Heinrich (2010), Barber (1991, 1994), Baines (1989), Gleba (2008), and Gillis and Nosch (2007), as well as from conversations with contemporary weavers who employ traditional methods. The various estimates used in this section for the amounts of time required for different stages in this process are derived from the same sources. Particularly enlightening in this regard were the information and insights generously provided by master weaver Sara von Tresckow of Woolgatherers Ltd., of Fond du Lac, Wisconsin.

3. On ancient Greek vertical weighted looms, see Barber (1991), Hoffmann (1974), and McLauchlin (1981).

4. The two most famous such vase paintings are the depiction of Penelope weaving, now in the museum at Chiusi, in which her loom appears to be just over 2 m long (CVA online vase #216789, ARV 1300, 2), and the similarly sized loom being used by two women on a black-figure lekythos by the Amasis Painter (New York, Metropolitan Museum of Art 31.11.10; CVA online vase #310485). Many more images of Greek looms, as well as diagrams attempting to reconstruct the details of such looms, can be found in the works listed in the next note.

5. The estimates for setting up the loom and for weaving the cloth have to be regarded as just that—rough estimates—because very few weavers today (even those interested in traditional methods of weaving) have extensive experience with the type of vertical warp-weighted looms that are depicted in vase paintings. There have, however, been some attempts to reconstruct and use these sorts of looms. Some of the more elaborate efforts have been made by scholars working on medieval textiles, the technology for which shared many characteristics with that of weaving in the ancient world. For descriptions of some of these experiments, see Barber (1991), Batzer and Dokkedal (1992), Walton (1988), Carroll (1983), and Hoffman (1974). Note also the experiment in reconstructing a Greek loom described at https://digital.library.txstate.edu/handle/10877/3320.

6. Even before the modern era, the spinning phase of cloth production was speeded up several times over by the invention of the spinning wheel, which seems to have first appeared in China and then spread to Europe by the very late Middle Ages. A second vast increase in spinning efficiency arrived with the invention of the spinning jenny in the eighteenth century.

7. Because of the need to let each of the layers dry fully before adding the next one, however, keep in mind that this work could not have been done in one stretch. Therefore, a minimum amount of time required to construct one linothorax when the cloth was already in hand would have been 10 to 14 days.

8. While we did not construct an entire linothorax from such fabric scraps, we did make one that used very different weights and weaves of fabric for various layers of the

laminated slab. We also made some test patches out of scraps and employed them extensively to repair and resurface damaged test patches and linothorakes.

9. The "cost" of military equipment and its relationship to the economic status of hoplites is dealt with in more detail later in this chapter.

10. Later in his text, Jarva does actually go on to offer an analysis of ancient prices, attempting to demonstrate that leather was cheaper. This analysis is discussed below in more detail.

11. On the various tanning methods available in the ancient Mediterranean, see Forbes (1966). On leather processing and making leather armor, see also Coles (1962, 175–79).

12. One can still readily observe the many gradations of leather thickness and quality that are derived from different sections of cows, oxen, and other ungulates by visiting the shop of a cobbler who works with traditional tools and methods, such as the one at colonial Williamsburg. The very thickest leather, around 1 cm, comes from the uppermost section of a mature ox's back, and cobblers usually reserve such pieces for the soles of shoes. It is this back leather that would have been most appropriate for armor and is likely the equivalent of the 750-denarii oxhide of Diocletian's Edict. The toughness and thickness of this leather also would have made it hard to work with. It would not have been easy to stitch together several smaller pieces of leather to make one corselet of armor, which is another reason why leather corselets were probably cut out of a single large hide.

13. Diocletian's Edict also includes eight gradations of higher-quality linen, with the finest priced at 1,200 denarii per pound (26.4–11). Wealthy individuals could certainly have chosen to have linen corselets made with a wide range of finer materials in order to show off their status.

14. Determining prices for other pieces of a hoplite panoply is similarly vexed. Jarva (1995, 148–52) conveniently summarizes the available evidence. One of the more unambiguous bits of information is a fourth-century B.C. inscription from Thasos, which specifies 300 drachmae as the value of a panoply that is to be given to war orphans. The described panoply includes cuirass, helmet, shield, greaves, spear, and dagger. A late Archaic inscription from Salamis gives a cost of 30 drachmae for a panoply, although the specific items are not listed (*IG* I2 1; Meiggs-Lewis, no. 14). Even adjusting for inflation, the wide range suggested by these two figures reiterates the difficulty of placing reliable monetary values on ancient weapons. See also the discussion of this issue, and the related one of the social and economic class of hoplites, by van Wees (2001, 2004).

15. Jarva (1995, 153) also offers calculations of values for linen and leather corselets based on Diocletian's Edict. He ends up with a substantially higher figure for linen and a much lower one for leather. For the leather, the difference is due to his assumption of two corselets per hide rather than one, and because he uses the price for an untanned oxhide rather than a tanned hide. For the reasons explained in chapter 2, however, Type IV armor could not have been made out of rawhide. We used the figure of 750 denarii for a tanned hide "of the first quality," "suitable for sole leather," because this seemed most analogous to the material that would have been used for leather armor. Diocletian also gives a price for a tanned oxhide of the second quality, which is 400 denarii (8.10). If such a hide were used, then the leather corselet materials could have been bought for considerably less than those needed for a linen one, but the numbers are still of a comparable order of magnitude.

While we would like to believe that our estimates are more accurate, other computations, including Jarva's, are plausible. The fact that reasonable guesses covering such a wide range of figures can be produced using the same basic data again suggests how questionable such calculations for the ancient world really are, and how cautiously such numbers should be treated.

Jarva (1995, 153) boldly takes this series of calculations a step further by converting the Diocletianic numbers into late Archaic Greek currency based on daily wage estimates, with the conclusion that a linen corselet would have been expensive, roughly equivalent to a bronze cuirass in cost. While this again may be plausible, we are hesitant even to attempt to offer alternative figures, because this seems to be pushing rather meager evidence beyond what it can reasonably bear.

16. For examples of the wide range of flax growing and linen production, see Barber (1991, 1994), Gillis and Nosch (2007), Jenkins (2003), and Forbes (1956).

17. There were, of course, male weavers, but they engaged in this activity explicitly for profit. In this section, we are concerned with the weaving that went on within the domestic sphere, where it seems to have been a primarily female activity. On male weavers, see Thompson (1982).

18. So, too, Penelope is famously described as weaving in an upstairs room (Homer, *Odyssey* 1.361 and 15.517).

19. For an expression of the notion that there were strongly gendered sections in the ancient Greek house, see Walker (1983). For a summary of more recent ideas concerning this issue from an archaeological perspective, see Nevett (1994, 1995, and 1999) and Cahill (2002, especially 148–93).

20. The statistics for loom weights at Olynthus in this paragraph are all derived from Cahill (2002, 169–79).

21. One problem with data such as those from Olynthus is that the houses studied probably represent the wealthier end of the economic spectrum. Smaller houses tend to be more confused archaeologically and often are not counted. The problem is even more acute for apartments and other sorts of multifamily dwellings. On the issue of the archaeological bias toward larger houses, see the comments of Nevett (1999, 156–58). For a study of "modest" housing units at Delos, see Trümper (2005). On housing for the poor in ancient Greece, see Ault (2005).

22. There is a lively debate about the economic status of hoplites. For discussion of this issue, see especially van Wees (2001, 2004).

23. Another way to visibly display status was by the degree of ornamentation of one's armor. Thus, one might have pieces of equipment gilded, attach expensive and decorative plumes to one's helmet, or have elaborate designs painted on one's armor.

24. See van Wees (2004, 53). He offers a fuller analysis of the relationship between the high cost of bronze armor and its appeal as a status symbol, arguing that a key purpose of such armor was "conspicuous consumption" and the desire to "dress to impress" (52–54).

25. Few if any of the Classical era Greek city-states seem to have provided arms and armor for their soldiers. Athens apparently began to do so only in the late fourth century B.C., and even then the issue consisted solely of a spear and a shield (*Athenaion Politeia* 42.4).

26. See, for example, Aristophanes, *Peace* 1209–64; Aeneas Tacticus 30.1–2; and Xenophon, *Hellenica* 3.3.7.

27. *The Oxyrhynchus Papyri*, vol. 71, no. 4807, ed. R. Hatzilambrou et al. (2007), 21.

28. The soldiers complain that "now our arms have become dull, and now our armor has worn out [*Iam tela hebetia sunt, iam arma deficiunt*]" (Quintus Curtius 9.3.10).

29. The emphasis placed by Curtius on the richness of the new armor's ornamentation suggests that Alexander's motive for replacing the old corselets may have been less that they were no longer functional (however worn they might have become) than that, given his newly won wealth, he wanted his army to display a more impressive appearance. The new armor would also have lent a more standardized look to his troops—perhaps a deliberate strategy to encourage a sense of communal identity now that he had begun to incorporate different nationalities into his army.

30. It should be noted that 25,000 corselets would not have been sufficient to equip Alexander's entire army, which (according to Diodorus 17.3–5) numbered around 50,000 just prior to embarking on his campaign against Persia. By the time of the invasion of India, Alexander may have commanded double this figure, although many were scattered about in garrisons. Because there was a very wide variety of different types of troops in Alexander's army and some of these would have worn no body armor while others would likely have had metal cuirasses, a figure of 25,000 linen corselets (perhaps for the heavy infantry and some cavalry) seems quite reasonable. For a discussion of the evidence regarding the size of Alexander's army at various points, see Engels (1978, especially 146–52).

31. For a discussion of male weavers in ancient Greece, see Thompson (1982).

32. On this festival and the weaving of the *peplos*, see Brulé (1987), Simon (1983), and Parke (1977).

33. Whether the designation "the best" refers to their skill at weaving or to their perceived status as exemplars of womanhood is unclear. See Goff (2004, 52).

34. The references for all of these examples are usefully collected in Romano (1988, 129–31). In a few of these cases, there is some ambiguity whether the statue in question was a cult statue, and whether the statue was actually clothed in the garment or simply received offerings of clothing. In the majority of instances, however, clearly a special garment was ritually produced by a group of women and ceremonially placed upon the statue.

35. The temple inventories from Brauron, Athens, Miletos, and Delos include many examples of such offerings. For a discussion of the range of textile offerings at these temples and the symbolic meaning of their varied conditions, see Cole (2004, 213–25).

36. On the important communal and social aspects of spinning and weaving for women, see Barber (1991, 1994).

37. On these and other Japanese military good luck charms, see Bortner (2008). For a personal account by a Japanese pilot who describes such a belt that was made for him, see the autobiography of Sakai (1978, 56).

38. Examples of such scenes (sometimes involving mythological characters) include: R-26, Munich, Antikensammlungen 2307, ARV 26, 1, CVA Deutschland 12 München, Museum Antiker Kleinkunst 4, pls. 166.1, 172.1, CVA online vase #200160; R-61, Bologna, Museo Civico Archeologico, Pell. 274, CVA Italia 27 Bologna, Museo Civico 4 (III.I), pls. 53.1, 55.7, CVA online vase #206069; R-164, Frankfurt, Städel Institute STV9,

ARV 818, 16, CVA Deutschland 30 Frankfurt am Main 2, pl. 63.4, CVA online vase #210116; R-71, Brussels, Musée Royaux d'Art et d'Histoire R308, ARV 362, 16, CVA Belgique 2, pls. 15.3a, 15.3c, CVA online vase #203807; R-59, Madrid, Museo Arqueológico Nacional 11042, ARV 532, 49, CVA Espagne 2 Madrid, Museo Archeológico Nacional 2 (III.I.c), pl. 16.1a, CVA online vase #206026; R-183, Bologna, Museo Civico Archeologico PU274, ARV 793, 78, CVA Italia 5 Bologna, Museo Civico 1 (III.I.c), pls. 16.1, 17.1, CVA online vase #209786; R-184, Palermo, Museo Archeologico Regionale 2564, ARV 1021, 115, CVA online vase #214296; R-28, Paris, Cabinet des Médailles 863, ARV 187, 53, CVA online vase #201705.

39. R-157, New York Market, Christie's XXXX205374, ARV 451, 3, CVA online vase #205374.

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